

THE WAVEGUIDE

SAN BERNARDINO MICROWAVE SOCIETY NEWSLETTER

DEC 2021 - FEB 2022 | VOL 2 ISSUE 1

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PRESIDENT'S FEEDHORN

Greetings! As I write this I'm putting the final touches on the Keynote speech for the [QSO Today Virtual Ham Expo](#) (March 12-13, 2022). More info @ <https://qsotodayhamexpo.com>

I've chosen to speak at the Expo on the subject "The Importance of Amateur Radio and technical hobbies to Advancing the World's Technology." Those of you who were at the SBMS Meeting February 4, 2022 will recognize this subject as the underpinning for what we have done, and continue to do at SBMS to "Advance Communications Above 1000 MHz"

Having provided, supported, and utilized microwave beacons in our region for many decades, with thanks and appreciation to Chip N6CA and the many others who have built, maintained, placed, and overseen them, we are now in the process both of upgrading the capabilities of the existing beacons and providing a more "turnkey" version in order to increase the number of them and the number of bands they are on, both locally and at other places in the country and possibly in the world.

Many thanks to Mary N6VI and his helpers who have worked the process of reinstating our IRS 501(3)(c) non-profit status which will make it much easier to collaborate with, fund, and/or receive funding from other non-profits to these ends.

The "beacon project" is not quite completely defined but remains in active discussion. The goal is to provide an open design for beacons that are "mountaintop ready" (or "university engineering building top ready") that can be implemented with tractable levels of volunteer, amateur labor (and test equipment), given

some possible assistance that SBMS and other ham organizations like it can provide.

Clearly there is a lot of "thinking work" ahead, all the way from identifying or defining community needs and user paradigms to detailed hardware, firmware, and software requirements and implementations. The goal of the Society, as always, is to be a center for discussion and consensus; to provide connections for ideas, advice, and components; and for everyone to have a good time building and using the sorts of systems that we are all in the Society to learn about and promote.

Keep in mind what we said at the meeting:

We are the rearguard of amateur radio - every radio entity today wants the microwave bands, but amateurs must, at a minimum, remain involved and engaged there.

We are the cutting edge of amateur radio - anyone working or playing in radio today, amateur or otherwise, needs to know microwave radio technology.

We are, in short, - Where It's At !

73 Courtney N5BF SBMS President



SAN BERNARDINO MICROWAVE SOCIETY OFFICERS & CONTACT INFORMATION

The San Bernardino Microwave Society is a technical amateur radio club affiliated with the ARRL having a membership of over 90 ham radio members.

The focus of the club is microwave activities in the Southern California. Our sister club is the San Diego Microwave Group (SDMG).

SBMS dues are \$15 per year, Dues can be handed to the treasurer at the meeting, or mailed to the address of the treasurer listed in the banner below. Meetings are first Thursday of the month, starting at 7:00 PM.

CURRENT COVID-19 NOTIFICATION

Normal meeting activities have commenced again at the American Legion Hall.

The State of California has lifted the requirement of masks, however, if you are unvaccinated the State of California still has a requirement to wear a mask inside the building. Please be considerate of everyone at the meeting.

For more information on our virtual club meeting and a ZOOM invitation, please contact Courtney Duncan N5BF at courtney.duncan.n5bf@gmail.com or W6IFE@W6IFE.COM

SBMS WEBSITE
WWW.W6IFE.COM

SBMS GENERAL EMAIL
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N5BF



Vice President
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Dick Bremer
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Corresponding Secretary
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Lab Manager
Dave Glawson
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ARRL Interface
Frank Kelly
WB6CWN



Newsletter
Steve Barden
WA6OXN



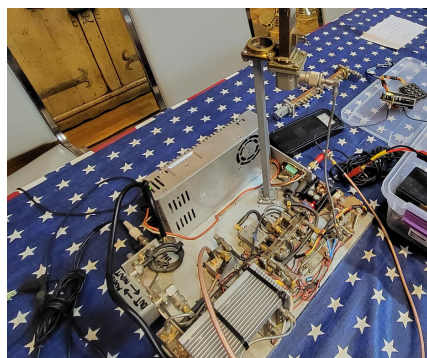
W6IFE Website
Frank Kromann
AG6QV

DECEMBER 2021 - SOCIETY MEETING CHRISTMAS GATHERING



December 2021 - SBMS Christmas Meeting

In Attendance - WA6OXN Steve, WA6JBD Mel, WA6CGR Dave, N6CA Chip, W6DL Dave, KM6OKE George, K6HLH Larry, KM6RXN Robert, W5NYY Michelle, KB5MU Paul, N5BF Courtney, N6WL Bill, KC6JPG Roland, WA6SVT Mike, WB6HYH Mike, AF6EP Eric, Sean O, W6KVC Gary
We had a number of folks also attend via ZOOM online. Thank You to all who participated !



SBMS KICKOFF TO 2022

Congratulations are in order to Courtney N5BF for his accomplishment in the 1296mhz Band and achieving a very impressive WAC - WORKED ALL CONTINENTS Award !

Editors Note: We always hear the words of encouragement about pursuing our hobby, amateur radio in the microwave arena; but when the President of SBMS throws down the glove, he does it in a most impressive way !!

I believe this makes the San Bernardino Microwave Society one of the most important Amateur Radio clubs in the U.S.A. as the membership actually "Walks the Walk" and not just "Talk Talk Talk"...



FEBRUARY 2022 SOCIETY MEETING NOTES

Society Meeting Notes - February 3, 2022

Presiding at the meeting were President - Courtney Duncan N5BF, Secretary - Michelle Thompson W5NYV, Vice President - Robert Carter KM6RXN, Treasurer - Dick Bremer WB6DNX.

Courtney Duncan opens the meeting at 1904 Hrs and informs the Society that Society Officer Nominations are in March, elections are in April.

Program by Drew Arnett N7DA on his contest rig for 10 GHz. Drew spent some time dispelling myths about 10 GHz that many amateur radio operators have about the band. MUD article KK7B "any band microwave or not".

Even simple rigs can be entertaining and fun. Participation over rig worth. Arduino + DRO HB100 = transmitter. A simple receiver is block LNB, DC block repurposed splitter, F connector bits, and a power meter to an amplified speaker is all you need. Link budget can be estimated from this, with a margin of 49 dB, gives 256 meters. Not great performance, but the important this is that you are on 10 GHz and having fun. Can you make essentially a crystal radio with an LNB, LNB + 1N34A + high-Z headphones?

What about 555 + DRO module plus stripped wire end key? And so on. Add a SAW filter to bring 500 MHz down to 11 MHz and get more range. MUD article for Maker Faire foxhunt was written. LNB + Bias-T + RTL_SDR + Laptop/Raspberry Pi is a common design pattern. Find this at 618 MHz.



Paul Wade W1GHZ is doing a great service making his work available to the community. Patience and persistence to build up the assemblies that Paul's kits have. Drew outlines W1GHZ's XVTR board and notes that the board looks like the block diagram, which makes it easy to study and learn. It is SMT, but it's not too hard. SMT is achievable. Magnification is key. Group build at SDMG was mentioned. 27 kits were organized by Kerry N6IZW and this turned out to be a very nice community building activity. Kerry's kit breakdown with 10 MHz TCXO, PLL, LO, multiplier and transverter was presented.

Drew then presented his rig that he built using the W1GHZ and KX3 boards as a base, and including things like the Arduino and synthesizer that folks used during the group build. No LNA. No PA. Ugly bug construction on a piece of Lexan plastic. Some tack soldering involved. Impact testing was done with an HT from two feet accidentally in the car.

T/R power control board was made up when it became obvious there was a need for it. Then needed a TX attenuator board. 8 V regulator board included to allow for 12 V battery power.

Top level assembly diagram presented. Tripods? Not easy to find a good cheap tripod. If you find one, and don't need one, try and pick it up to pass it on to a new microwave enthusiast.

Design Challenge: Design and publish an open hardware design for a microwave tripod?

Dish Dovetail mounts are available in a number of sizes. No extra holes needed to be drilled with these. Dovetail rail bolted to aluminum bolted to bottom of a Wild Blue dish. Easy to put together. Elevator shaft is threaded, so use it for an eye bolt and loop for ballast to avoid blowovers.

This rig plays pretty well. Operating photographs shared, on a mountaintop with K1CT.

"QRP" breakdown presented next. Topography and atmosphere dominate performance. 5 dBm output. Not much, but enough to participate. 38 dBm EIRP estimated. Big Gun stations make it easier to operate QRP.

Micro-roving! Drew shared several stories from his micro-roving efforts. This is when we move the minimum distance between attempts to contact, scurrying around making contacts.

Advantages? Simple, less battery, enough to have a lot of fun, learn the ins and outs of 10 GHz, and you get to hand out points.

Disadvantages? Receiver is deaf. Kind of bad noise figure. Plenty to upgrade.

What to do next? Have fun, make the upgrades, package it for SOTA, foster participation, make the information more readily available. Public policy stuff too. Everyone can bring patience and persistence. This can make it possible to do a lot with not a whole bunch of money.

Loaner gear and mentoring. Tune-up events are great places to onboard people into 10 GHz. Robert emphasizes that 10 GHz on Field Day is a fun and neat way to make contacts and get new people involved. QRP on 10 GHz really does work.

Parts keep getting cheaper. Spirited and wide-ranging conversation ensued.

FEBRUARY 2022 SOCIETY MEETING NOTES

SBMS Open Source Beacons, Courtney Duncan N5BF presenting slides.

Motivating thoughts. We are the rear-guard action of amateur radio. We are materially holding the amateur microwave bands every way we know how against extremely powerful encroachment. We are the cutting edge of amateur radio. Future amateurs and the professional technologies that some will become need experience in the microwaves. Amateur radio is the seed corn of Radio. That's why we do any of this - that's who we are and what we do. We are all in this together. There should be no infighting. Everything anyone does for the great good is for the good. We are looking for ways to pay it forward.

What amateurs often do today is just buy the solution. Or, adapt surplus, some engineering required. Or design and distribute an inexpensive starting point. There are a lot of people working to make things happen.

Why does this society think they want to buy beacons? It's hard to buy something that is outdoors-deployable. A lot of microwave activity starts and is sustained and enabled by beacons. Pretty much everyone needs them to get and stay on the air. Human resources are the bottleneck. Not money. At least, not at this point. People and time are the things in shortest supply. There was a meeting, a set of actions, to build a beacon and document it, and then ask if it makes sense to make more. Original design concept presented as a slide. Mountaintop-ready box, with a mountain-top ready feed, and a mountain-top ready antenna.

501(c)(3) registration as a public charity has been received. Thank you to Marty Woll for leading the effort to restore non-profit status. The non-profit status helps with the beacon effort. It makes it a bit easier to fund-raise and accept donations. We are recognized by both federal and state governments. We have one final step to complete with the state Department of Justice. 501(c)(3) makes it easier to take advantage of things like meeting rooms.

What We Could Do

Think in terms of components.

Add one component (yes, that's scope creep)

Consider the possibilities.

Possibilities:

Beacon (test receiver)

Reverse Beacon (plenty of good stuff can be learned with this and they report autonomously, and you can test your transmitter)

User Rig, when you put it all together.

"Beacons enable enabling"

Get a ton of stuff on the air and you can have something closer to total information awareness. This is how astronomy is done these days. There's automated telescopes that look all night long and astronomers come in the next day to look at the data, which is often sifted through by machine learning.

None of it is so hard that we haven't been able to do it.

It shouldn't be as easy as buying an HT. That's not why we are here. But, the bar could be lower and there could be standard ways to get on the air. There is a big gap here that we need to look at filling.

Multiple beacon projects have been presented. Both narrow and broad band. Once you have something digital and re-programmable, then reconfiguration is possible.

Going forward, looking at what we committed to do. Do one, publish, discuss.



Resources? Group build, CGR's lab, lots of resources. Yes, the devil is in the details. It's intended to be net fun. Not everything is all fun. Filling out the details is what we are already good at. Courtney is not worried about that. He's just trying to set the big picture and to ask What Is It That We Want To Accomplish?

How can we pay it forward? To ensure we do not lose our bands. Amateur radio enables things that are overlooked by commercial, academic, and other interests. We come through over and over here. How can SBMS continue this heritage of remarkable innovation?

Question: How to use a reverse beacon?

Answer: Worldwide monitoring station that listens for activity. Distributed receivers are coordinated and report what they hear. So, you can see your own footprint.

FEBRUARY 2022 SOCIETY MEETING NOTES

Question: How to use a reverse beacon?

Answer: Worldwide monitoring station that listens for activity. Distributed receivers are coordinated and report what they hear. So, you can see your own footprint.

Dave Laag, what are you thinking and where are we at?

Chip has been doing most of the work here on building one type of beacon design. All of us have used his beacon product for the last 30 years so we know that what he produces will be a top solution. The concept? We need to take what he winds up with and make it productized and kit-ready. Other areas need beacons. Anything underserved. Which is pretty much everywhere else.

"Everything won't be available completely" Chip explaining the design, and emphasizing the reproducible nature of the design. Not tested yet and not complete, but expecting to have one on the air in 3 weeks. Different requirements for different applications. Modular approach necessary.

Robert approaches a Weaver method beacon design. Audio generated through computer source.

Editors Note: The Society Meeting Notes are just a very quick memo of the presentations and discussions during the meeting. please let me know if you have any questions.

Rebuilt Frazier Beacon - Courtesy of Chip N6CA



Attending Members

N5BF Courtney	KM6RXN Robert	W5NYV Michelle
KB5MU Paul	W6DL Dave	WA6JBD Mel
N6VI Marty	WB6HYH, Tom	AF6EP Eric
WA7IKP Steve	WA6CGR Dave	WA6OXN Steve
WA6BBQ Jason	KK6MXP Jim	N6WL Bill
N6VHF Neil	KC6JPG Roland	WB6DNX Dick.

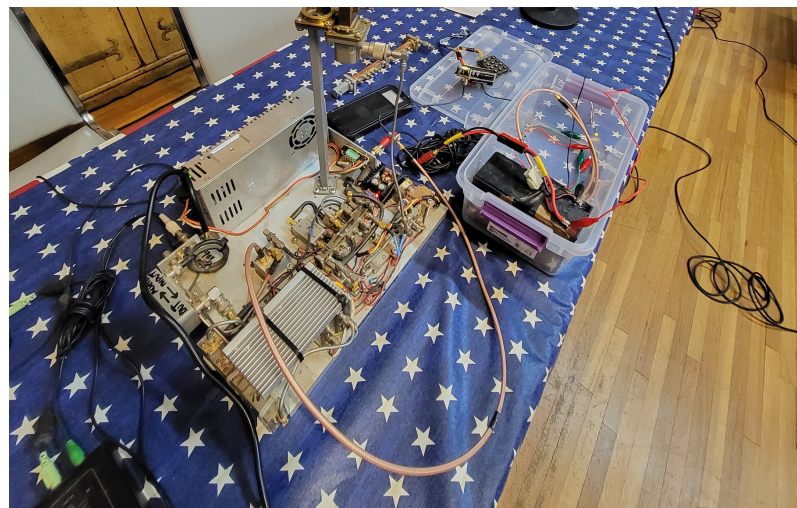
Attendance via Zoom

Dan Slater	Doug Millar	G8EMY	K6MG Gary
WA5VJB	W6HK Ken	Lars Karlsson	N9RIN
KB6BA Oliver	N6LL Paul	NI6E Peter	W6SZ Rein
Steve Noll	K6ML Mike	N6CA Chip	N8KH Ken
WD5EHM Gwen	N6RMJ Pat	Bill Kaiser	W6BY Brian

W1GHZ 10 ghz Transverter Kit



Robert KM6RXN - New 10 GHZ Rig Concept



JANUARY 2022 SOCIETY MEETING NOTES

Society Meeting Notes - January 3, 2022

The January meeting largely consisted of a technical introduction to the 122ghz microwave projects ongoing here on the West Coast. The presentation was done entirely on Zoom. The presenters were K6JEY Doug Millar, KC6QHP Tony Long, and K6ML Mike Lavelle.

I think the best way to present this is to redirect you to an online presentation put together by the K6ML Mike. The link is below.

http://www.bay-net.org/uploads/1/2/2/7/122774721/122_ghz_radio_k6ml.pdf

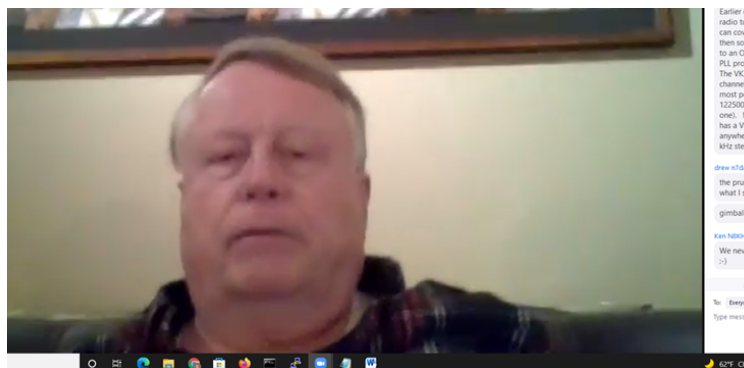
I have included a few pics from the live Zoom presentation which was excellent. The (3) presenters did a very good job with their segway to each part of the live video.



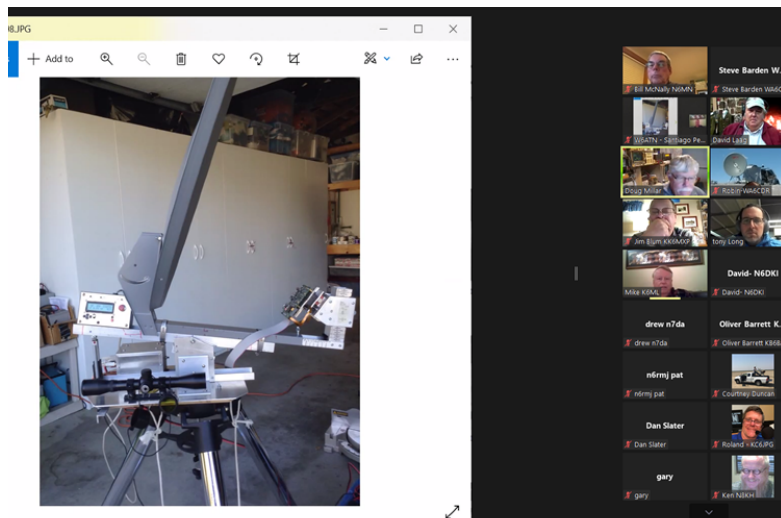
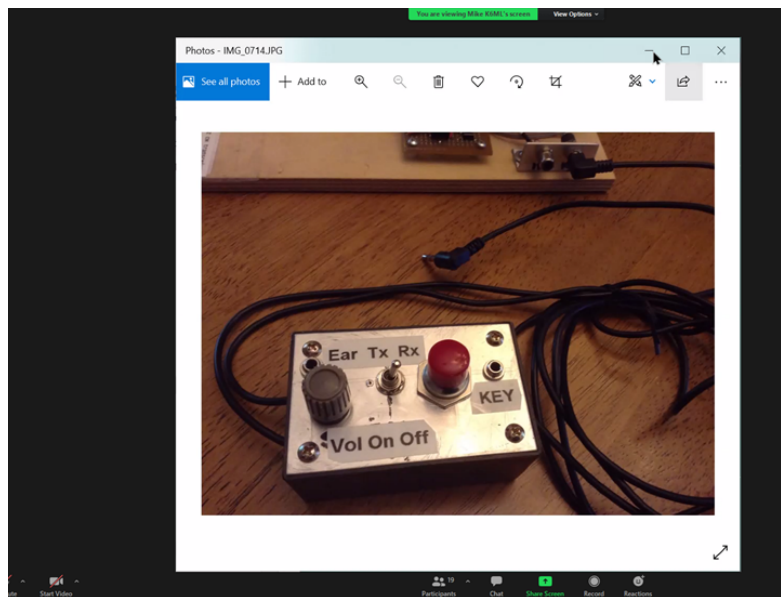
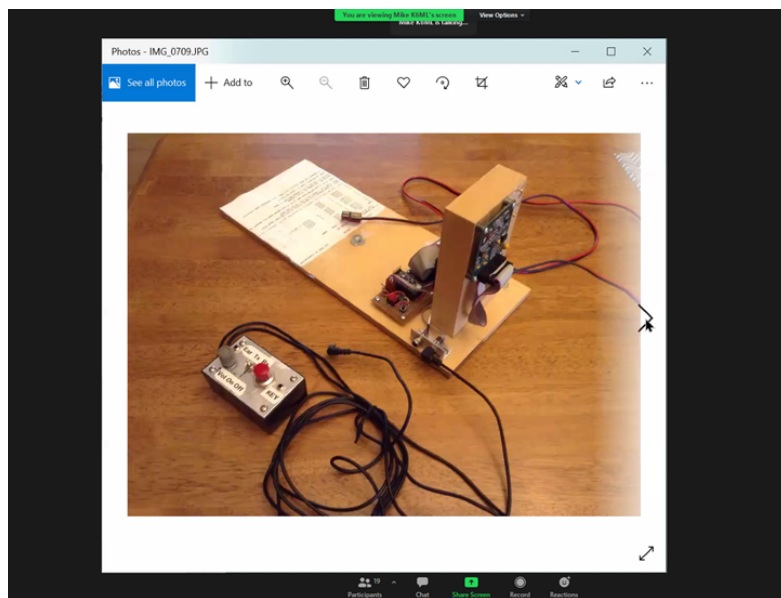
K6JEY DOUG MILLAR



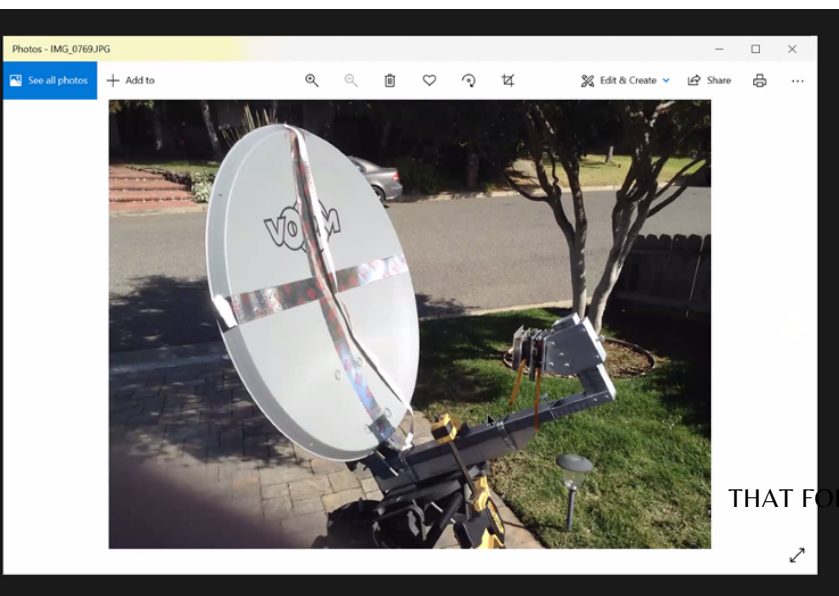
KC6QHP TONY LONG



K6ML MIKE LAVELLE



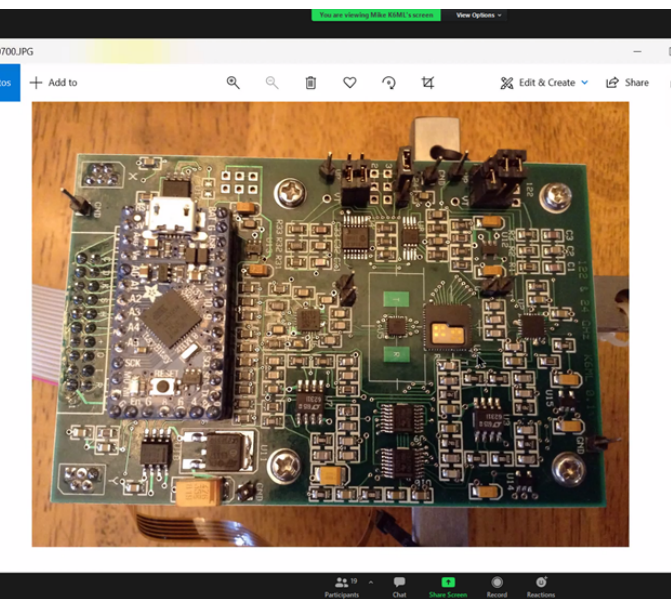
JANUARY 2022 SOCIETY MEETING NOTES



THAT FOLKS USED



it's the small things that keep you from messing up!



**NEWS
FLASH!**

**K6ML Mike Lavelle and N9JIM Jim Moss
and the announcement of their
accomplishment as the new world
record holders for 122 ghz !**

Please see the links below for more information;

<http://www.arrrl.org/news/new-world-distance-record-claimed-on-122-ghz>

<https://ghz-europe.com/122ghz-new-world-record-139-km/>



A NEW WORLD DISTANCE RECORD OF 139 KILOMETERS (86.2 MILES) IS BEING CLAIMED BY RADIO AMATEURS IN NORTHERN CALIFORNIA. THIS TOPS THE RECORD OF 114 KILOMETERS SET IN 2005 BY WA1ZMS AND W4WWQ, ACCORDING TO THE DISTANCE RECORDS ON THE ARRL WEBSITE.

THE FEBRUARY 17, 2020, CONTACT WAS BETWEEN MIKE LAVELLE, K6ML, ON MOUNT VACA (CM88WJ75ON) AT 835 METERS (2,739.5 FEET) ABOVE SEA LEVEL, AND OLIVER BARRETT, KB6BA (AT 1225 UTC), AND JIM MOSS, N9JIM (AT 1250 UTC), BOTH ON MOUNT UMUNHUM (CM97BD18VJ) AT 1,016 METERS (3333.3 FEET) ABOVE SEA LEVEL.



JANUARY 2022 SOCIETY MEETING NOTES

Attending Members

N5BF Courtney	KM6RXN Robert	W5NYV Michelle
KB5MU Paul	W6DL Dave	WA6JBD Mel
WB6HYH, Tom	AF6EP Eric	AF6NA Brian
N6WL Bill	N9RIN Chris	KI7BLI John
W6KVC Gary	KN6YR Jeff	K6HLH Larry

Attendance via Zoom

N6MN Bill	Dan Slater	K6JEY Doug
WA6OXN Steve	WA6CDR Robin	KK6MXP Jim
K6ML Mike	KC6QHP Tony	N6DKI David
N7DA Drew	KB6BA Oliver	N6RMJ Pat
AG6HF Dan	KC6JPG Roland	K6MG Gary
N8KH Ken	Rein Smit	



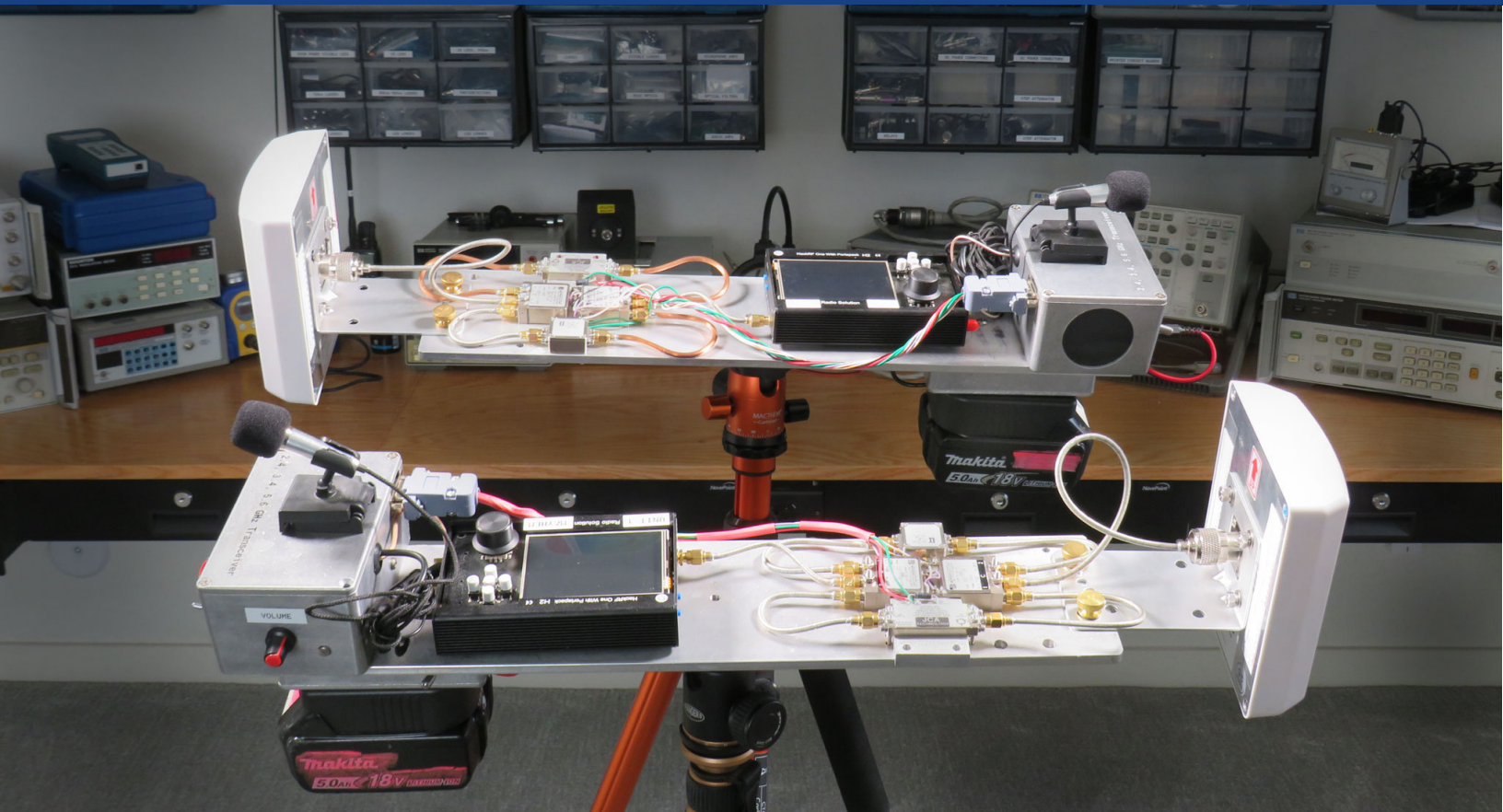
Zoom Meeting

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Participants 19 Chat Share Screen Record Reactions

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HackRF-One Portapack - Microwave Transceivers

One project here at WA6EJO is a pair of HackRF One Portapack microwave transceivers. I've used these on 13cm, 9cm, and 5cm. They are outfitted with panel antennas. It takes two antennas to cover the three bands. One panel is 13 dBi at 13cm and 5cm. It takes a second panel for 3 GHz.

A pair of SMA relays handle the TR switching between a Lotus Comm Systems LNA700M6P0G 1dB NF preamp and a JCA JCA48-4111B1 power amp. The HackRF One barefoot puts out about 0.1mW to 5mW. The power amp delivers 175mW to 580mW depending on the band. ERP is 3.5W to 50W depending on band and panel antenna.

20 dB quieting ranges from -95 dBm to -116 dBm depending on band.

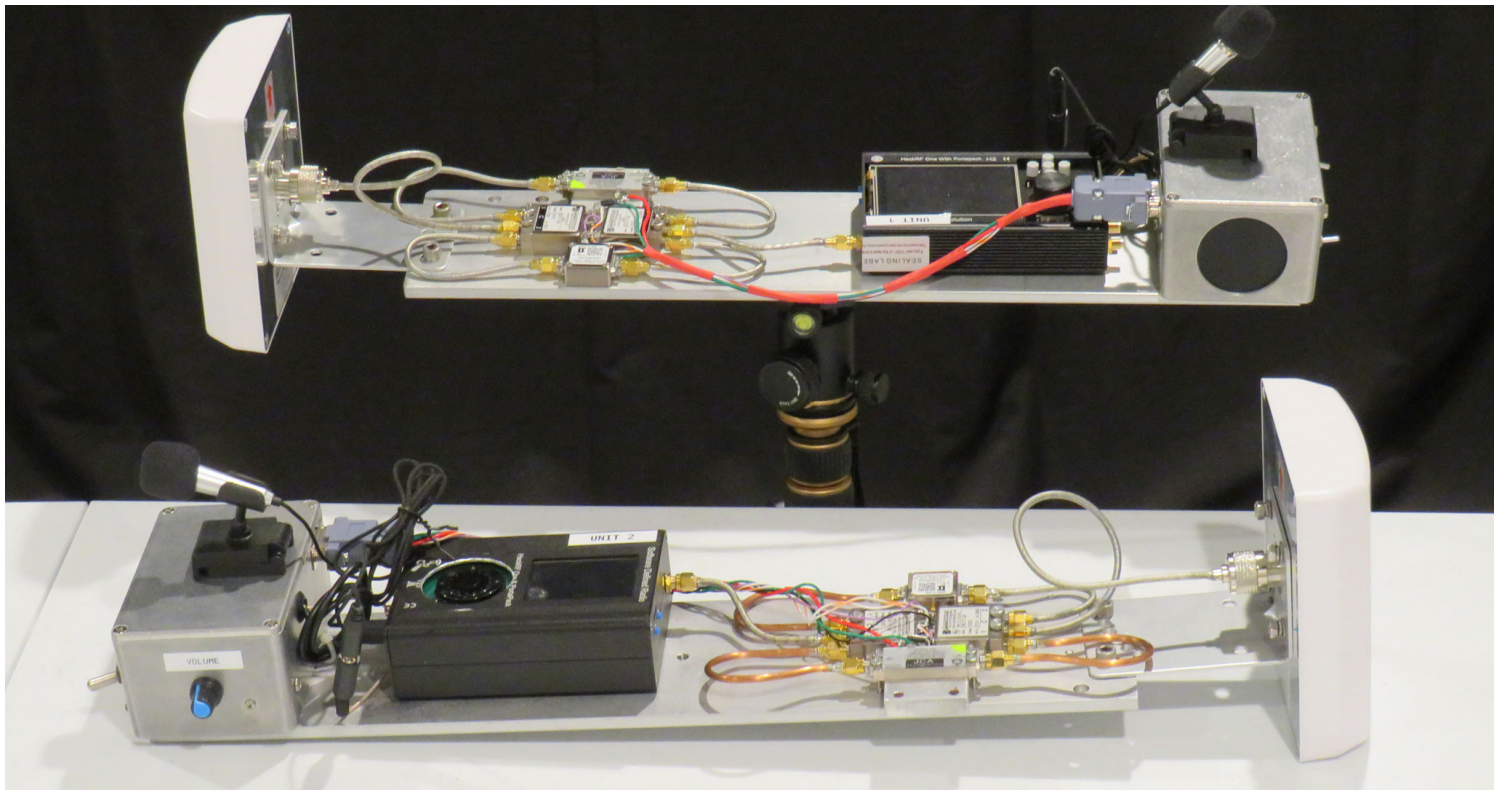
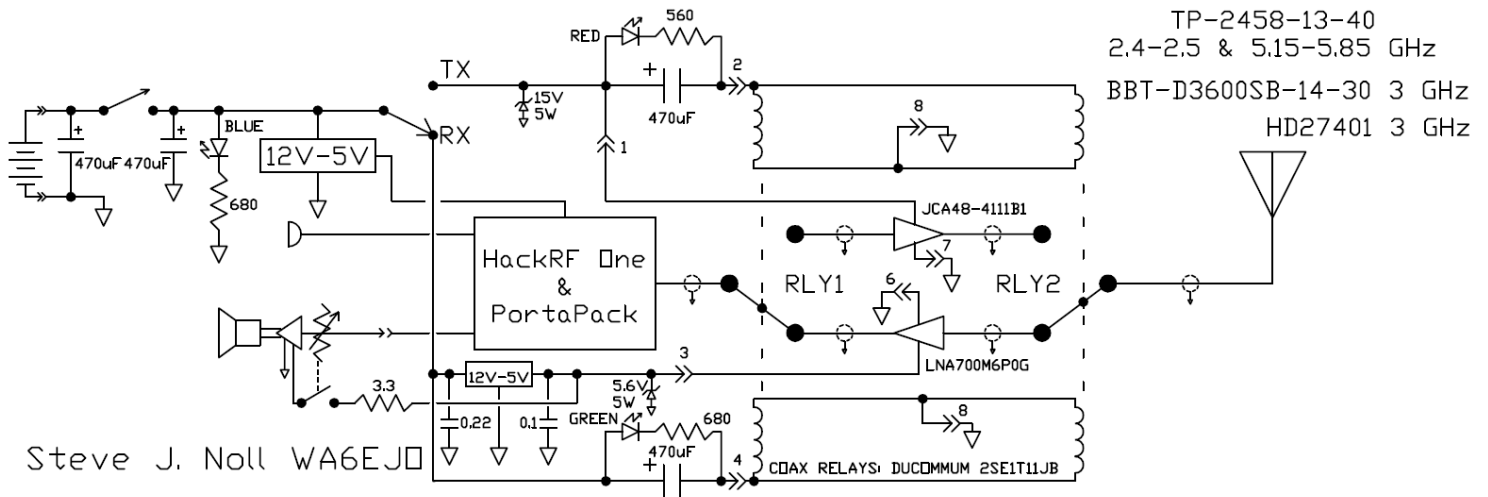
The rigs are powered from Makita power tool batteries.

The transceivers are equipped with microphones and audio speakers. They are a little fussy to set up to transceive with a bit of menu selecting and button pushing.

73, Steve Noll WA6EJO Ventura

Note: HackRF-One is a wide band software defined radio (SDR) half-duplex transceiver created and manufactured by Great Scott Gadgets. It is able to send and receive signals. The transmitter can send 1-50 milliwatts. Its creator, Michael Ossmann, launched a successful Kickstarter campaign in 2014 with a first run of the project called HackRF (Project Jawbone). The hardware and software's open source nature has attracted hackers and amateur radio enthusiasts. The HackRF-One is capable of receiving and transmitting on a frequency range of 1MHz to 6GHz with output power of 50 mW to 1 mW depending on the band. The unit comes with an SMA antenna port, CLKIN/CLKOUT SMA ports and a 2.0 USB port. The HackRF-One integrates with GNU Radio, SDR#, and SDRAngel software projects to provide its graphical user interface.

HACKRF-ONE PORTAPACK - MICROWAVE TRANSCEIVERS





Medtronic

Standard Letter
CRDM Technical Services U.S.
Mounds View, MN
Brady (800) 505-4636
Tachy (800) 723-4636
Instruments (800) 638-1991

RADIO FREQUENCY TRANSMISSION

Rev B, 16-FEB-2009, Page 1 of 2

PACEMAKER (IPG – IMPLANTABLE PULSE GENERATOR)

DEFIBRILLATOR (ICD – IMPLANTABLE CARDIOVERTER DEFIBRILLATOR)

This document addresses radios that transmit only or radios that transmit and receive, e.g. ham radio, citizens band, cellular phone, or other wireless electronic devices. Radios that receive only are not of concern.

Medtronic implanted devices have a highly selective filter designed to avoid sensing of Electromagnetic Fields (EMF). Some types of EMF can exceed the capability of this filter to reject it. This may cause a pacemaker to erroneously detect the EMF and either continuously pace or inhibit pacing. It may cause an ICD to erroneously detect the EMF as a rapid heart rate and deliver a therapy.

Guidelines for safe operation of radio equipment encompass such factors as transmission frequency, type of modulation, and the power being emitted from the antenna. These factors require the ICD/pacemaker wearer to maintain a certain distance from the antenna to avoid having a voltage induced on the leads. A high frequency, high power, continuous wave will not cause the ICD or pacemaker to falsely sense, but an amplitude or pulse modulated signal could cause inappropriate sensing at moderate output power. EMF from radio waves will not alter the programmed parameters of an ICD or pacemaker in any way.

Any time a cellular phone is on, i.e., listen or standby mode, it MAY TRANSMIT WITHOUT USER INITIATED ACTION because of system-initiated instructions. Talk into the hand-held phone with the phone against the ear opposite the side of an upper thorax implant. Do not carry the cellular phone in pockets or on a belt adjacent to or over the implant site. It is especially important that a phone with power turned ON (listen mode), not be carried in locations close to the implant site. A carrying location at the side of the body opposite an abdominal implant is recommended.

RF SAFETY ARTICLE PACEMAKER & DEFIBRILLATOR

RADIO FREQUENCY TRANSMISSION

Rev B, 16-FEB-2009, Page 2 of 2

The following guidelines are suggestions for safe use of radio equipment:

Power in Watts	Minimum Distance of device from Antenna	Example(s)
3 watts or less	6 inches (15 cm)	Cellular Telephone, Cordless Telephone, Cordless Microphone, Home wireless electronics, Smart key/Remote car starter
>3 – 15	12 inches (30 cm)	Citizens Band, Long Range Cordless Telephone, Invisible Fences, Walkie-Talkies
>15 – 30	24 inches (60 cm)	Marine band radios, GPS survey equipment, some jobsite radios
>30 – 50	3 feet (1 meter)	Commercial and government dispatch, e.g. taxis, emergency vehicles
>50 – 125	6 feet (2 meters)	
>125 – 250	9 feet (3 meters)	
>250 – 500	12 feet (4 meters)	
>500 – 1000	20 feet (6 meters)	
>1000 – 2000	30 feet (9 meters)	Commercial broadcasting towers, Ham Radio
>2000	No exposures >100V/meter	High power broadcast towers

If the antenna transmits in a very directional pattern, it may be necessary for the patient to be further away from the antenna at the strongest part of the pattern. There is no concern when operating the transmitter/receiver when the cabinet shielding and coaxial cables are properly connected.

Radio frequency wireless communication technology such as Bluetooth for TV's, radios, computers, smart key/remote car starter, and other electronic devices should follow the recommendations above. Radio frequency waves are used to communicate with or control remote electronic devices. Maintain a minimum 6 inch (15cm) distance between the transmitter/receiver and the implanted device. If the transmitter/receiver is closer than 6 inches (15 cm), there is a potential for inappropriate pacing, inhibition, triggering, reversion or ICD shock.

RF SAFETY ARTICLE

MICROWAVE POWER DENSITY FOR PARABOLIC DISH ANTENNAS

MICROWAVE POWER DENSITY ESTIMATION FOR PARABOLIC DISH ANTENNAS

PETER DENEFF, AE7PD

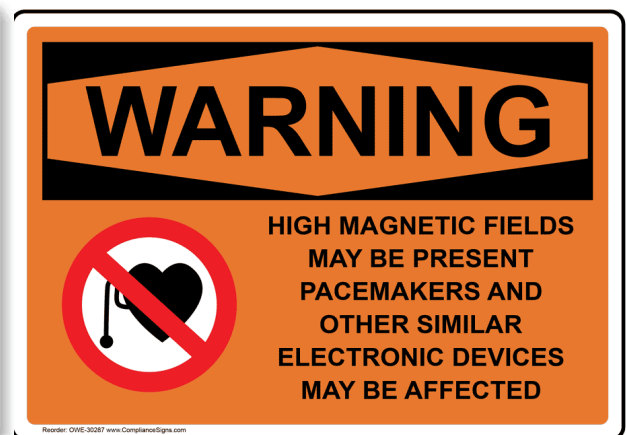
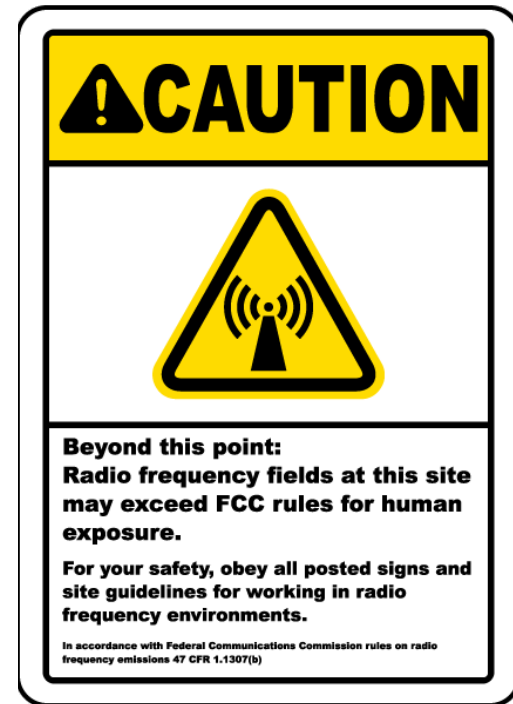
MICROWAVE EXPOSURE SAFETY WITH PARABOLIC DISH ANTENNAS

SUMMARY

IN THE ARTICLE "MICROWAVE POWER DENSITY ESTIMATION FOR PARABOLIC DISH ANTENNAS" IN QEX (JAN/FEB 2022, PP 23-25) I COMPARE METHODS AMATEURS CAN USE TO ESTIMATE THE MAXIMUM ANTENNA INPUT POWER NOT EXCEEDING THE FCC MAXIMUM PERMISSIBLE EXPOSURE LIMITS.

THE FAR FIELD MODEL USED IN THE ARRL RF EXPOSURE CALCULATOR [1] GIVES ACCURATE ESTIMATES FOR POWER DENSITIES AND SEPARATION DISTANCES IN THE FAR FIELD. THE FCC FORMULA FOR THE DISTANCE TO THE FAR FIELD BOUNDARY IS $RFF = 0.6 D^2 / \lambda$, WHERE D = DISH DIAMETER, AND λ = WAVELENGTH [2]. FOR EXAMPLE, $RFF = 24$ FT FOR A D = 2 FT, 10 GHZ DISH ANTENNA.

AN ANALYSIS OF THE NEAR FIELD OF PARABOLIC DISH ANTENNAS PUBLISHED BY GEORGE KIZER INCLUDES A TABLE FOR THE MAXIMUM ANTENNA INPUT POWER NOT EXCEEDING THE FCC MAXIMUM PERMISSIBLE EXPOSURE LIMITS [3],[4],[5]. THE ANALYSIS IS FOR COMMERCIAL DISH ANTENNAS, WHERE POWER LOSS IS USUALLY NEGLIGIBLE. THESE ESTIMATES ARE SHOWN IN TABLE 1 BELOW. THEY ARE CONVENIENT, CONSERVATIVE (LOW) LIMITS YOU CAN USE FOR AMATEUR RADIO ANTENNAS, WHICH TYPICALLY HAVE A MORE UNIFORM APERTURE ILLUMINATION THAN COMMERCIAL ANTENNAS, AND NON-NEGLIGIBLE POWER LOSS [6].



RF SAFETY ARTICLE

MICROWAVE POWER DENSITY FOR PARABOLIC DISH ANTENNAS

TABLE 1. MAXIMUM ANTENNA INPUT POWER NOT EXCEEDING THE FCC MAXIMUM PERMISSIBLE EXPOSURE LIMITS IN THE NEAR FIELD. DISH DIAMETER IS D (FT), AND APERTURE ILLUMINATION EFFICIENCY IS 0.55. DATA FROM [3],[4],[5].

D (FT)	GENERAL POPULATION LIMIT (W)	CONTROLLED LIMIT (W)
1	0.1	0.5
2	0.4	2.0
3	0.9	4.5
4	1.6	7.9
6	3.6	18.0
8	6.3	32.0
10	9.8	49.0

REFERENCES

[1] [HTTP://WWW.ARRL.ORG/RF-EXPOSURE-CALCULATOR](http://www.arrrl.org/rf-exposure-calculator)

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[3] G. KIZER, "MICROWAVE ANTENNA NEAR FIELD POWER ESTIMATION," PROCEEDINGS OF THE 4TH EUROPEAN CONFERENCE ON ANTENNAS AND PROPAGATION, 12-16 APRIL 2010 PP 1-5.

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[4] G. KIZER, DIGITAL MICROWAVE COMMUNICATION: ENGINEERING POINT-TO-POINT MICROWAVE SYSTEMS , IEEE, 2013, PP. 249-319.

[5] G. KIZER, "ANTENNA NEAR FIELD POWER DENSITY PUBLIC SAFETY LIMITS," NSMA ANNUAL CONFERENCE, MAY 17-18, 2016.

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[6] P. WADE, W1GHZ, THE W1GHZ ONLINE MICROWAVE ANTENNA BOOK, 2006.

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RF SAFETY ARTICLE

MICROWAVE POWER DENSITY FOR PARABOLIC DISH ANTENNAS

Editors Note: This is a very informative transcript of an email exchange regarding this topic by some of the more experienced radio engineers. so, I thought it was well worth including

MICROWAVE RF SAFETY ARTICLE IN QEX SBMS

COURTNEY DUNCAN
<COURTNEY.DUNCAN.N5BF@GMAIL.COM>
JAN 17, 2022, 2:52 PM

JAN/FEB 2022 QEX PAGE 23 IS AN ARTICLE BY AE7PD ABOUT RF SAFETY LIMITS WITH MICROWAVE RIGS LIKE OURS.

TO CUT TO THE BOTTOM LINE, THE "GENERAL" EXPOSURE LIMIT IS 1 MW/CM² WITH 30 MINUTE AVERAGING AND THE "CONTROLLED" LIMIT IS 5 MW/CM² WITH 6 MINUTE AVERAGING.

NONE OF US HAVE ANY PROBLEM WITH THIS IN THE "FAR FIELD" (TENS OR HUNDREDS OF METERS FOR $2D^2/(\text{WAVELENGTH})$) SO HE SPENDS A LOT OF EFFORT TALKING ABOUT NEAR FIELD EXPOSURES. ONE ESTIMATE HE MAKES IS TO JUST DIVIDE THE AREA OF YOUR DISH "DISK" (FLAT APERTURE FROM RIM TO RIM) BY POWER ASSUMING YOU HAVE ACHIEVED UNIFORM (E.G. "IMPOSSIBLE") ILLUMINATION.

MY DISH (IN THE DIRECTION OF PROPAGATION) IS ABOUT 5000 CM² (THAT IS, ABOUT HALF A SQUARE METER) SO 10 WATTS EVENLY ACROSS IT IS ABOUT 2 MW/CM².

NOW, I'VE ALWAYS KNOWN THAT THE APERTURE OF THE FEEDHORN IS PRETTY "HOT" WHEN THE KEY IS DOWN; INDEED, THIS IS HOW I CAN CHECK THAT MY TRANSMITTER IS WORKING, BY WAVING MY HAND RIGHT IN FRONT OF THE FEED. BUT I WAS A LITTLE SURPRISED THAT THERE MIGHT BE OTHER NEAR-FIELD AREAS THAT COULD BE CONSIDERED HAZARDOUS.

NOW, THE WORST-CASE KEY-DOWN DUTY CYCLE ANY OF US USES IS ABOUT 50% (PEAKING AND JT MODES, CW OR SSB BEING SOMEWHAT LESS THAN 50% AVERAGE POWER) AND OUR DISHES ARE NOT 100% EFFICIENTLY ILLUMINATED. (THE AUTHOR USES 0.55). AND EVERYTHING WE DO WOULD BE CONSIDERED IN THE "CONTROLLED" EXPOSURE CLASS WITH THE HIGHER LIMIT.

... AND I DON'T TYPICALLY STAND IN FRONT OF THE DISH OR THE FEED WHEN OPERATING. AND I DON'T EXPECT ANYBODY TO HEAR ME WHILE MY ... HAND IS IN FRONT OF THE FEED.

SO I DON'T THINK THERE IS ANYTHING FOR ANY OF US TO WORRY ABOUT IN OUR TYPICAL OPERATIONS. BIGGER APERTURE IS LESS PROBLEM. LOWER POWER IS LESS PROBLEM.

BUT THERE IS A QEX ARTICLE THAT IS RELEVANT TO MICROWAVE OPERATION AND SOME OF US MAY GET QUESTIONS OR INQUIRIES ABOUT IT. SO THAT'S MY TAKE. WE'VE THOUGHT ABOUT IT AND AREN'T WORRIED.

(HEY IF THE AVERAGING TIME WERE A YEAR, AN ACTIVE SBMS OPERATOR WOULD BE AT SOMETHING LIKE 4X12 + 2X12 + 4 HOURS OPERATING TIME (TWO CONTEST WEEKENDS WITH 12 HOUR/DAY LIMITS, 12 HOME TO HOMES AND THE TUNEUP) = 76 / 8766 ~ = 0.9% EVEN IF ALL OF THAT WAS 100% KEY DOWN.)

73 COURTNEY N5BF

DREW ARNETT <ARNETT.DREW@GMAIL.COM>
JAN 17, 2022, 3:44 PM

'AND EVERYTHING WE DO WOULD BE CONSIDERED IN THE "CONTROLLED" EXPOSURE CLASS WITH THE HIGHER LIMIT.'

SPEAK FOR YOURSELF. :-)

GOOD POINT THOUGH THAT OTHERS MAY ASK US QUESTIONS.

DREW
N7DA

ROBIN <WA6CDR@CQ160.NET>
JAN 17, 2022, 5:42 PM

BACK IN THE EARLY DAYS OF IMPLEMENTATION OF OET65, SOME WERE TAKING THE APPROACH THAT A DISH FOCUSED TO A PINPOINT OF ONE SQUARE CM AND THE POWER IN THAT ONE SQUARE CM WAS THE TX POWER TIMES THE ANTENNA GAIN

RF SAFETY ARTICLE

MICROWAVE POWER DENSITY FOR PARABOLIC DISH ANTENNAS

THIS SEEMED TO HAPPEN ON CROWDED ROOFTOPS - A 10 FT HPX WITH A ONE WATT TRANSMITTER MADE 50KW WORTH OF RFR.- MADE IT AS BAD AS AN FM STATION WITH A ODBD ANTENNA AND 50KW OF RF IN THEIR MINDS

WITH A RASTER OF ONE SQUARE CM, THE HIGHEST POSSIBLE POWER IS 100% OF THE TRANSMITTER POWER. THE RATIONAL VIEW AS COURTNEY SAYS, IS THAT THE DISH CREATES (NEAR FIELD) A CYLINDER OF RADIATION THAT IS THE DIAMETER OF THE DISH, AND 100% OF THE TX POWER IS EVENLY SPREAD ACROSS THE FACE OF THAT CYLINDER (WE WISH WE COULD MAKE IT THAT GOOD!)

THERE WERE PLACES THAT DENIED MICROWAVE SYSTEMS SITE ACCESS BECAUSE THE ERP WAS TOO HIGH

EARLY USFS IMPLEMENTATION HAD THIS SAME SILLY THINKING - THEY WANTED TO LIMIT EVERYTHING TO 100W ERP, AND DENIED ALL MICROWAVE FOR EXCESSIVE ERP, BUT THAT DIDN'T LAST, NOW ITS 500W RF AND THEY GRUMBLE BUT IGNORE MICROWAVE- MOSTLY BECAUSE THE LICENSE READS DBM NOT KW, AND THEY DON'T UNDERSTAND THE MATH. BUT THEY STILL CANT REALLY GET IT THROUGH THEIR HEADS- THEY HAVE RECENTLY DENIED WEATHER RADAR INSTALLATIONS BECAUSE THE LICENSE READS 5 KW ERP

WE DID HAVE SAFETY PERIMETERS SET UP FOR GROUND MOUNTED SATELLITE TX IN THE EARLIER DAYS WHERE IT TOOK HUNDREDS OF WATTS OR MORE OF RF POWER. TRUCK MOUNTED ANTENNAS WERE NOT A PROBLEM AS YOU COULD NOT WALK IN FRONT WITHOUT CLIMBING A LADDER. THE REALLY OLD C BAND TRUCKS WITH THE DISH ESSENTIALLY ON A TAILGATE AND 1 KW TRANSMITTERS HAD SAFETY PERIMETERS DEPENDING ON WHERE THEY POINTED

DON'T LOOK INTO THE WAVEGUIDE APERTURE WITH THE TX KEYED, AND THAT'S ENOUGH IN OUR WORLD - COURTNEY'S CALCULATION IS A PERFECTLY REASONABLE ONE TO USE WHEN ANY QUESTION COMES UP - AND IT MIGHT WITH US POINTING ACROSS A PUBLIC WALKWAY IN SOME PLACES.

AND IT APPLIES TO THE "SURFACE" THAT IS THE DIAMETER OF THE DISH AND ESSENTIALLY RIGHT BEHIND THE FEED. GO 50 WAVELENGTHS AWAY AND ITS SPREAD SOME. I SUPPOSE WE COULD CALCULATE THE END OF NEAR FIELD FOR OUR DISH DIAMETERS.

WITH THAT CYLINDER OF RADIATION, STICK A HEAD SIZED OBJECT INTO IT AND IT COLLECTS THE 2MW/SQ CM ACROSS THE HEAD "SURFACE" AREA. WELL WITHIN THE LIMITS. AND DON'T KEY DOWN FOR 30 MINUTES WITH SOMEONE LOOKING AT YOUR ANTENNA FROM 3 FT AWAY.....

ROBIN



**ROBIN <WA6CDR@CQ160.NET>
JAN 26, 2022, 5:03 PM**

THIS APPEARS TO SAY ITS OK TO BE OUTSIDE THE CYLINDER & WITHIN 2 FT OF THE CYLINDER. IT VALIDATES THE CYLINDER VIEW OF RADIATED ENERGY...

SEEMS A BIT STRINGENT - IF THE DISH IS 6 FT AND THE PERSON IS 6 FT TALL AND STANDS FULLY EXPOSED, , THE ENERGY SPREAD OVER THE BODY IS - SEEMS TO ME ABOUT 1/4 OF THE AREA OF THE CYLINDER FACE -

6 FT DISH = 28.26 SQ FT = 26255 SQ CM

RF SAFETY ARTICLE

MICROWAVE POWER DENSITY FOR PARABOLIC DISH ANTENNAS

IF THE BODY AREA EXPOSED IS 1/4 THAT'S 7065 SQ CM
10,000 MILLIWATTS TOTAL POWER, 2500 MILLIWATTS
APPLIED TO THE BODY = 0.354 MILLIWATTS PER SQ CM

A GOOGLE LOOKUP SAYS ADULT MALE IS 1.9 SQ METERS
SURFACE AREA, AND FRONTAL WOULD BE HALF, OR 950
SQ CM, SEEMS AWFULLY SMALL,

ANYWAY, IT IS A LOT LESS THAN 1 MW/SQ CM

ROBIN

MEL SWANBERG <WA6JBD@VERIZON.NET>
JAN 26, 2022, 8:25 PM

THE 'CYLINDER' APPROACH TO RF SAFETY AROUND A
MICROWAVE DISH MAKES SOME SENSE TO ME. GOING
BACK TO A SERIES OF MICROWAVE PATH ENGINEERING
SEMINARS I ATTENDED THAT WERE PUT ON BY DICK
LAINE OF FARINON CORP, HE POINTED OUT THAT THE
NEAR FIELD OF A DISH ANTENNA MAINTAINS THE
DIAMETER OF THE REFLECTOR UNTIL THE TRANSITION
TO FAR FIELD. THE IMPLICATION THERE WAS THAT A
DISH COULD BE MOUNTED AT THE EDGE OF A BUILDING
AND SHOOT OUT PARALLEL TO A WALL UNTIL THE END
OF THE NEAR FIELD, MEANING MOST OF THE ENERGY IS
CONTAINED WITHIN THAT CYLINDER. OR, OTHER
OBJECTS COULD BE CLOSE TO THE PATH CENTERLINE
IN THE NEAR FIELD, AND SO LONG AS THEY WERE
OUTSIDE THE CYLINDER DEFINED BY THE DISH
DIAMETER, THE OBJECT WOULD NOT BE A FACTOR IN
PATH PERFORMANCE.

IT STANDS TO REASON, THEN, THAT IF ONE KEEPS THEIR
HEAD OUTSIDE THE DISH DIAMETER, YOU DON'T NEED
TO BE OVERLY CONCERNED ABOUT EXCESSIVE RF
LEVELS.

THAT ALWAYS WORKED FOR ME, BUT THEN, WHAT DO I
KNOW... IT'S ONLY BEEN 2 YEARS SINCE MY CATARACT
EYE SURGERY, LIKELY CAUSED BY EXCESSIVE EXPOSURE
TO MICROWAVE RADIATION.

SHRUG

MEL



REVIEW OF THE BOOK: TO THE MOON AND BACK

ESSAYS ON THE LIFE AND TIMES OF PROJECT DIANA

Reviewed by Courtney Duncan N5BF 01/17/22

(23 cm EME operator from DM04vf)

Author: Cindy Stodola Pomerleau W2AXO

Interested in all things Moonbounce and thinking it was nearly the only historical information on the subject, I spent several years at the end of my JPL career reading the extensive history blog that starts at [The First Amateur Lunar Tests & Contacts 1953-1965 \(ok2kkw.com\)](http://TheFirstAmateurLunarTests&Contacts1953-1965(ok2kkw.com)) at the rate of about one "EME year" per un-pre-committed lunch hour. This took a long time because such lunch hours were pretty rare at the end of my career.

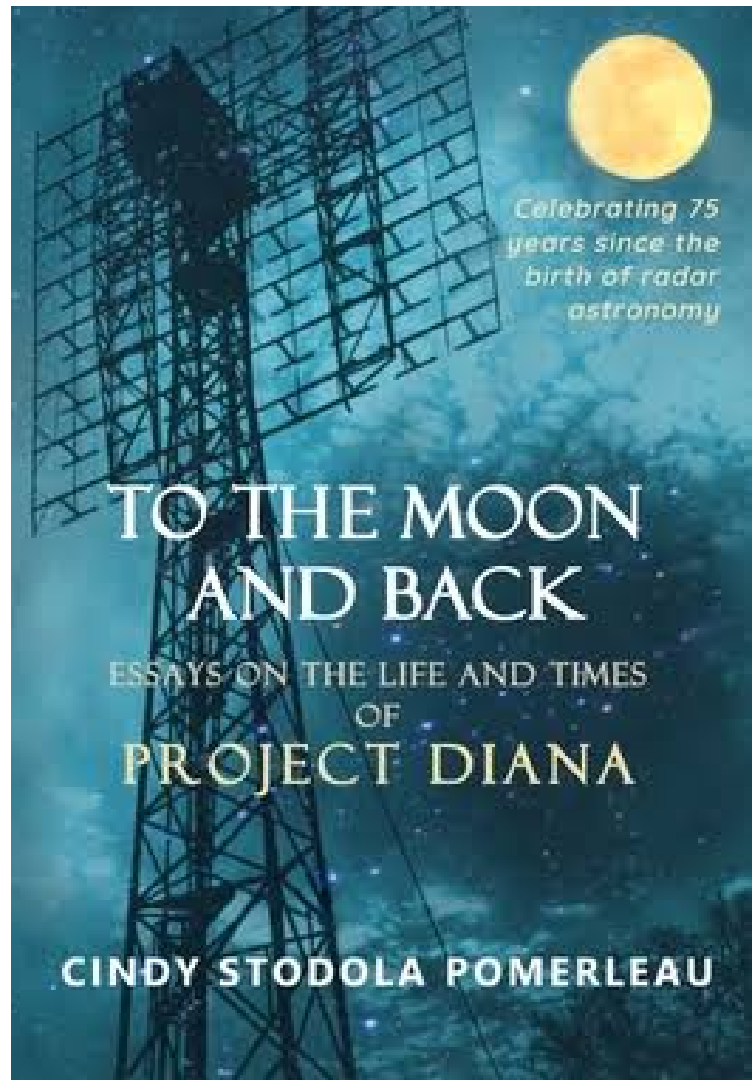
This collection of articles by various authors dates back to the first amateur echo detections in 1953, proceeds through the first EME two-way QSO in 1960, and culminates in reproductions of articles from amateur radio magazines about moonbounce technology and operating events up into recent decades.

When Cindy Stodola Pomerleau W2AXO posted this year on the EME reflector that she had written a book about Project Diana, the first ever radio moonbounce of any type, my interest was piqued and I obtained the Kindle version.

Pomerleau is the daughter of King Stodola (1914-1992, former holder of W2AXO), one of the five engineers who worked on Project Diana at the Evans Laboratory in Belmar, New Jersey on the Atlantic shore (FN20) immediately following World War II. She was three years old at the time. This book is a collection of blog posts that she wrote on a wide variety of "growing up there" topics including Project Diana.

At the time King Stodola's work was classified and she knew nothing about it in her youth except that it was important and secret. She was never allowed to visit his lab or office. Most of the information in this volume comes from oral histories that she did with her father in his retirement and from research on the subject done by others in the intervening years.

The first takeaway for me was the genesis of the project itself. As World War II was winding down in 1946 there was a question at the highest levels as to whether there was any way to detect incoming ICBMs which would be arriving via suborbital paths from outside the atmosphere.



Radar had been used during the war back to the infamous 'interpretation of data failure' at Pearl Harbor but at that time it was believed that radio waves could not penetrate the ionosphere and go to or come from outer space (this was long before radio astronomy).

If true radar detection of objects in space would be problematic and once an ICBM was in the atmosphere there wouldn't be time to do much. Meanwhile the radar lab in New Jersey, like the Manhattan Project, was facing budget cuts and possible closure as wartime impetus was waning. What could they do quickly to answer this question?

After some analysis, it was determined that detection of radio signals reflected from the moon should be possible, given a solution to several other technical problems such as lunar tracking with sufficiently high gain antennas and

REVIEW OF THE BOOK: TO THE MOON AND BACK

ESSAYS ON THE LIFE AND TIMES OF PROJECT DIANA

high power transmitters plus sensitive, low bandwidth receiving. The moon has a pretty big radar cross section at least and it wasn't so far away as to make reflections undetectable and a successful experiment would show that such signals could penetrate the earth's ionosphere not just once but twice.

Extrapolation from this to radar detection of ICBMs would then be "merely" a matter of adjusting the math and the resulting equipment.

Remarkably, and very much in the spirit of amateur radio, no special equipment was designed or produced for Project Diana. The first EME station was cobbled together from available materials and re-purposing of other equipment originally designed for other military uses just as they often are today.

King Stodola was himself a radio amateur with a high frequency shack in a small room at home. The children remember him operating CW from there on days off but didn't pay a lot of attention. He apparently lost avocational interest in radio after he acquired his first computer.

The technical details of the Diana system have been documented elsewhere from the amateur's point of view. The key parameters are: frequency 111.5 MHz, power 3000 watts, antenna gain (64 dipoles in a "bedstead" arrangement) 24 dBi gain, front end noise figure 3.5 dB, bandwidth 57 Hz. In addition, as with the case with some EME stations now, elevation steering of the antenna was considered out of scope, limiting the experiments to

about 40 minutes in duration at moonrise and moonset. (see April 2006 QST, page 13). Major Edwin H. Armstrong had some advising involvement, but further details are unclear from either this book or the QST article and are perhaps lost to history.

The moonbounce accomplishment was not widely heralded or advertised at the time. The U.S. military did not want anyone knowing that we had capabilities like that or were pursuing them, but in short order several other groups around the world attempted and succeeded at echoing radio signals from the moon and some public credit was ultimately given to the New Jersey team who did it first.

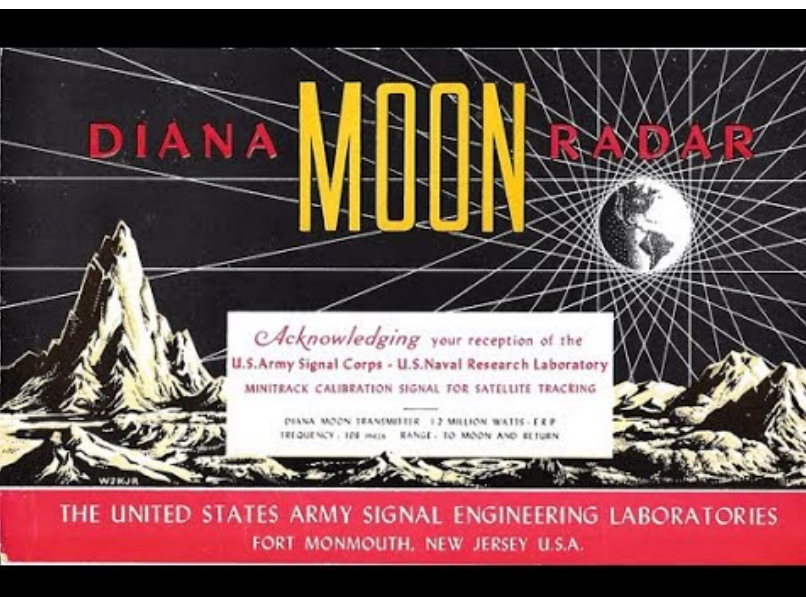
This lack of celebratory attention has not improved much in intervening years. The laboratory is now a museum but was barely rescued from demolition and redevelopment some years ago.

Indeed, attempts at major anniversary celebrations and recognition (such as the 50th in 1996) were not successful. A second takeaway for me was the notion of "two moonshots" each with similar importance, that is: Project Diana and Project Apollo. Project Diana was arguably an essential and enabling first step to Project Apollo among many other things. It was the first time that humans had "touched" the moon.

Pomerleau holds that Project Diana was arguably the first shot at the dawn of the Cold War.

Having just finished reading a history of the development of the Hydrogen Bomb, I was somewhat skeptical about this, but agree that Project Diana was a critical technological step both in international technological competition and toward much that we take for granted today.

Given a common belief that man-made radio signals could not penetrate earth's ionosphere, for example, any communication with people or equipment in space, including communications, weather, and navigation satellites could not even be contemplated. It is difficult to imagine a world without radio contact with the International Space Station, or Voyager, or GPS. And what we know about the universe due to radio astronomy, which came along some years later, is largely underappreciated.



REVIEW OF THE BOOK: TO THE MOON AND BACK

ESSAYS ON THE LIFE AND TIMES OF PROJECT DIANA

Not all of the book is about Project Diana. Those only interested in moonbounce can skip about half of the material. The other entries cover the history and other contributions of extended family, toys and activities in the 1940s and 1950s, Sears Catalogs, spam (the meat, not your e-mail), local real estate, and other topics that you would expect from a memoir writer from that place and time. I took a "life and times" approach to the book myself and read all of it. The author, a ham herself (she recovered the W2AXO call to keep it in the family), she is aware of the value of amateur radio and the extent of avocational moonbounce worldwide today and discusses this in several chapters.

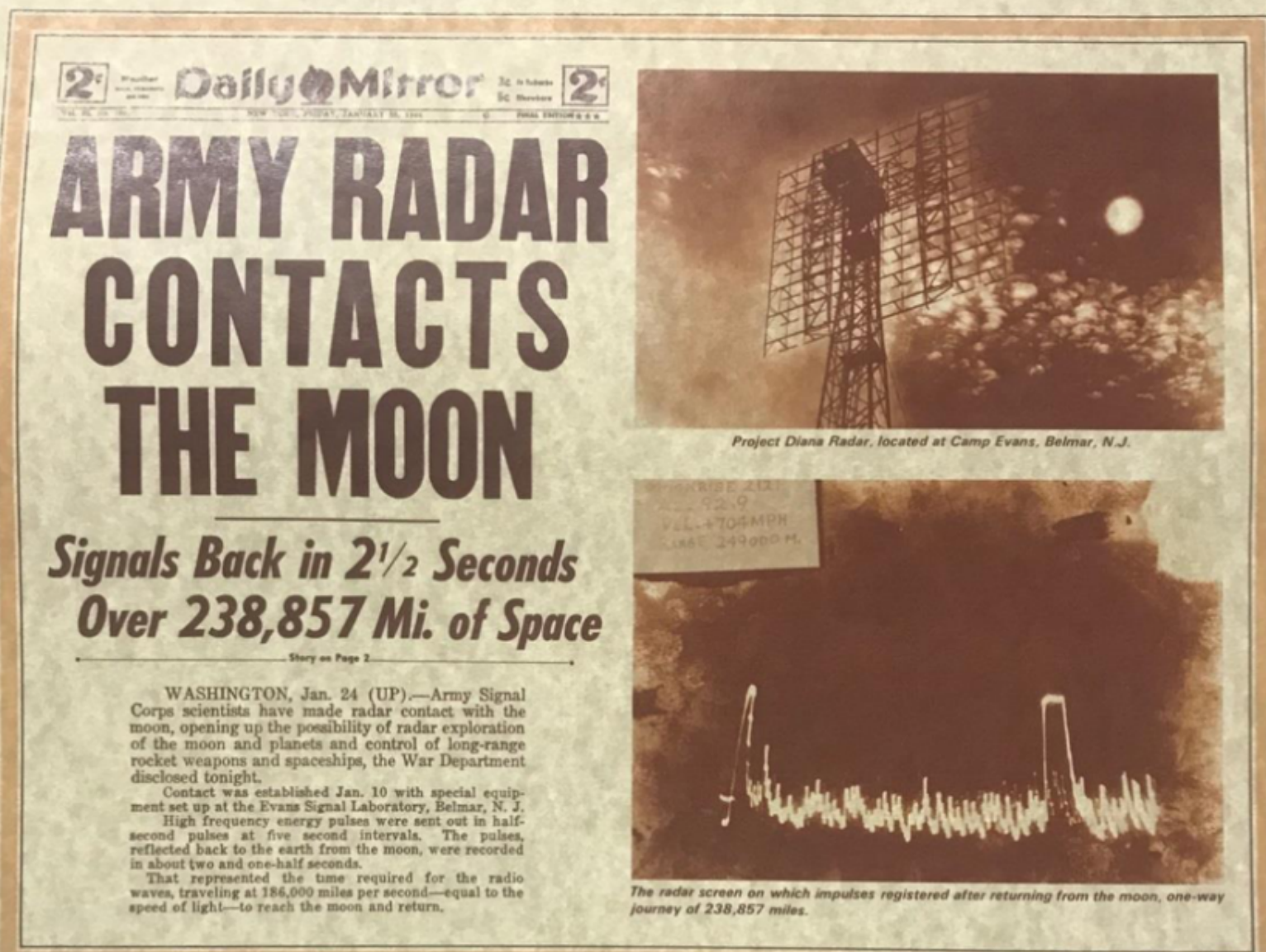
Our community and the world owe a debt of gratitude to Cindy Pomerleau.

In this effort to recognize and document the accomplishments and contributions of her father King Stodola, she has unearthed new information and revitalized old from this important episode 20th century technology achievement.

For me, the implicit reminder that assumptions about what will and won't "work" should be revisited from time to time is well worth entertaining.

People who don't know what is impossible often accomplish it!

AUTHOR-CINDY POMERLEAU



MICROWAVE BEACON 14.6 KM AND 168 KM PROPAGATION EXPERIMENTS

MICROWAVE BEACON 14.6 KM AND 168 KM PROPAGATION EXPERIMENTS

By Dan Slater (AG6HF), Greg Bailey (K6QPV), Kerry Banke (N6IZW)

{ Editors Note: This submittal has slight variations from the original PDF to accommodate the format of the newsletter. Please refer to W6IFE.COM for the original document and also the best display of the graphics. }

INTRODUCTION

The San Diego Microwave Group (SDMG) has 5 GPS locked CW / K6QPV/B beacons operating at 1296.32, 2304.36, 3456.3, 5760 & 10368.36 MHz. These are colocated on top of Mt San Miguel (DM12MQ, N32.698 W116.935) in San Diego County. All beacons are horizontally polarized except 1296.32 and 3456 which are vertically polarized. Propagation conditions were observed over both a short 14.6 km (9.1 mile) path and a longer 168 km (104 mile) path.

We were interested in how the beacon propagation varies with weather and microwave frequency. Over the longer path, large (>60 dB) signal strength variations were associated with changing weather conditions.

SDMG BEACONS

All 5 SDMG beacons are frequency referenced to a Rhode & Schwartz model ED170MP GPS Disciplined Oscillator (GPSDO). The upper 4 beacons use a common Basic Stamp microcontroller to produce beacon Morse ID signals every 120 seconds. The L-band beacon has a separate microcontroller.

The 2304.360 MHz beacon uses an Arduino microcontroller programmed by Drew Arnett (N7DA), to control an Analog Devices AD4350 PLL donated by Kerry Banke (N6IZW). The output of the PLL is 2,304.360 MHz with its stability is maintained by the 10 MHz GPS locked frequency reference. The output of the PLL is passed through a HP-33144A microwave switch ID keyer, a SMA attenuator, a bandpass filter, and finally to a Mini-Circuits Lab ZHL-42 power amplifier. The PA output was measured at 29 dBm.

The antenna is a horizontally polarized WA5VJB (Kent Britain) Log Periodic Dipole Array (LPDA) mounted 12' above ground on a 325 degree heading (Los Angeles metropolitan area). This antenna has 6 dBi gain resulting in a 32 dBm EIRP toward Los Angeles.

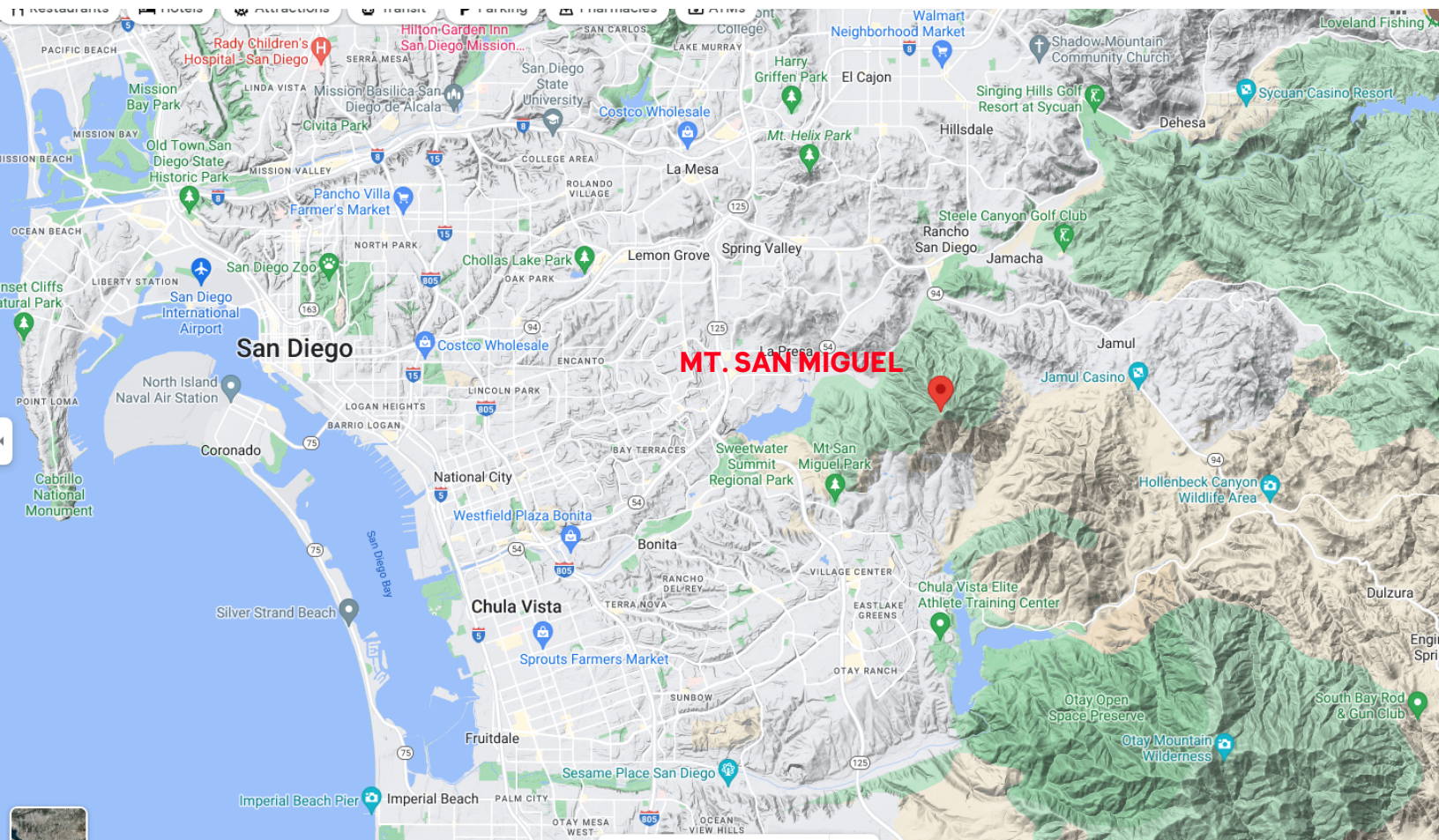
The 10368.360 MHz beacon consists of two assemblies, 1) a rack mounted cabinet containing the exciter and 2) a remote PA and slot antenna. The rack unit is composed of a GPS locked Verticom 2000 PLL programmed to generate the 10,368.360 MHz signal. The PLL output is passed through a HP-33144A microwave switch ID keyer which modulates the drive level to the PA. This signal is passed through a 27' section of Adam Russell 11556 low loss coax to the power amplifier and omni-slot line antenna on a 325 degrees heading (Los Angeles metropolitan area). The PA 27 dBm output drives the 10.4 dBi gain antenna resulting in 37.4 dBm EIRP

THE ANTENNAS LEFT TO RIGHT ARE:

- 450 MHz beacon control link
- 5760 slotted line antenna - One of the MUD 2005 door prizes was built by Dave Glawson / WA6CGR
- 1296 VERTICAL - PRIMARILY USED BY AMATEUR RADIO ASTRONOMERS FOR ALIGNING 1420 MHZ RECEIVERS
- GPS ANTENNA - BEACON FREQUENCY REF
- 3456 HOMEMADE HORN BY JERRY PETRIZZI, W6VLF
- 10.368 POWER AMP ENCLOSURE WITH WR-90 SLOT ANTENNA DONATED BY KERRY BANKE, N6IZW
- 2304 WA5VJB LOG PERIODIC DIPOLE ARRAY (LPDA) ANTENNA WAS INSTALLED AFTER THIS PHOTOGRAPH



FIGURE 1 -- THIS PHOTO SHOWS THE MT SAN MIGUEL BEACON ANTENNAS.



14.6 KM BEACON EIRP MEASUREMENTS

Short range 14.6 km (9.1 mile) line of sight propagation measurements from the base of Cowles Mountain were made to verify the predicted beacon EIRP toward Los Angeles. This is nearly in line with the 168 km receive site. EIRP was measured using a calibrated log periodic antenna followed by a wide-band preamplifier into a HP8562A spectrum analyzer. Antenna gain, preamp gain and cable loss were all factored in to the measured received power level. The estimated measurement uncertainty is +/- 3 dB and generally in good agreement with the power levels estimated from measured beacon RF amplifier output power and expected beacon antenna performance. The one exception is that the measured X-band beacon EIRP is about 7 dB below the predicted EIRP.

SOUTHERN CALIFORNIA AMATEUR MICROWAVE BEACONS

Frequency	Name	ID	Grid	Lat, Lon, Alt DD MM.MMM	PA out	Antenna	EIRP calc	EIRP 15 km	16 dBi RCV 168 km
1296.320 MHz	Mt. San Miguel	K6QPV/B	DM12MQ	N32 41.875 W116 56.109, 763 m	41 dBm	8.4 dBi	50 dBm	50 dBm	-74 dBm
2304.320 MHz	Heaps Peak	W6IFE/B	DM14KF	N34 14.083 W117 08.433, 1961 m	27 dBm	6 dBi	30 dBm		
2304.360 MHz	Mt. San Miguel	K6QPV/B	DM12MQ	N32 41.875 W116 56.109, 763 m	28 dBm	7.4 dBi	32 dBm	32 dBm	-96 dBm
3456.300 MHz	Mt. San Miguel	K6QPV/B	DM12MQ	N32 41.875 W116 56.109, 763 m	40 dBm	7.8 dBi	30 dBm	30 dBm	-118 dBm
5760.000 MHz	Mt. San Miguel	K6QPV/B	DM12MQ	N32 41.875 W116 56.109, 763 m	33 dBm	8.4 dBi	30 dBm	30 dBm	-123 dBm
10368.300 MHz	Palos Verdes	N6CA/B	DM03TS	N33 46.056 W118 22.585, 366 m	32 dBm	14 dBi	44 dBm		
10368.310 MHz	Frazier Mtn	N6CA/B	DM04MS	N34 46.506 W118 58.169, 2447 m	31 dBm	14 dBi	43 dBm		
10368.330 MHz	Heaps Peak	AF6HP	DM14KF	N34 14.083 W117 08.433, 1961 m	33 dBm	16 dBi	46 dBm		
10368.360 MHz	Mt. San Miguel	K6QPV/B	DM12MQ	N32 41.875 W116 56.109, 763 m	30 dBm	10.4 dBi	37 dBm	30 dBm	-106 dBm
10368.375 MHz	White Tanks	W7ATN/B	DM33RN	N33 34.165 W112 33.608, 1205 m	33 dBm	10 dBi	43 dBm		

All beacons are H linear polarization except 1296 & 3456 V pol - Note: EIRP (isotropic) = ERP (dipole) +2.15 dB EIRP 15 km is line of sight measured beacon EIRP, 16 dBi RCV 168 km is the predicted free space line of sight power using a 16 dBi gain antenna.

PROPAGATION PATH

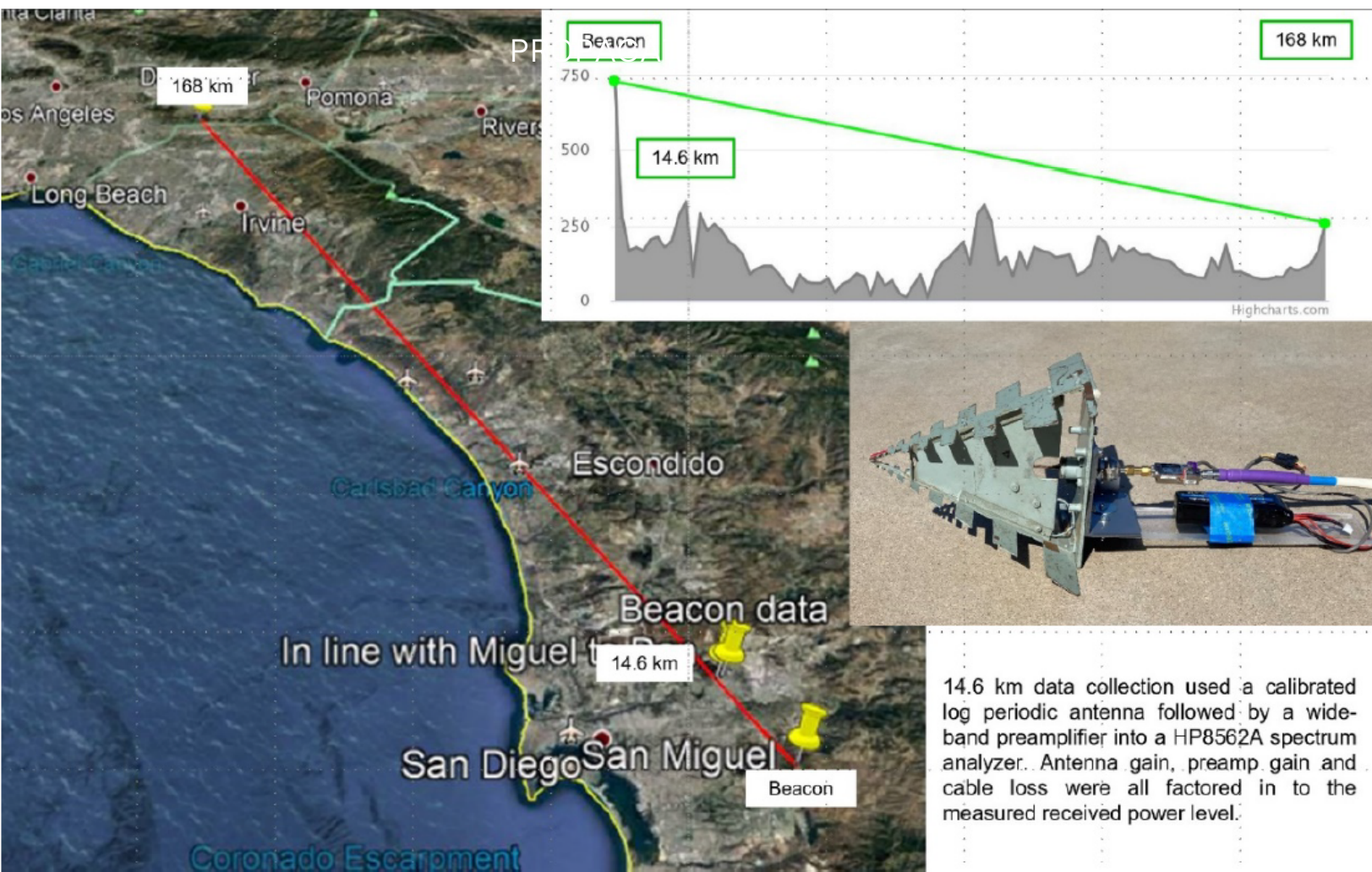


Figure 2 -- The propagation path obstruction map shows the 15 km and 168 km propagation paths. It appears that both receive site paths are unobstructed so free space line of sight path loss conditions may hold. Also shown is the receiving antenna and preamp for 15 km EIRP measurements.

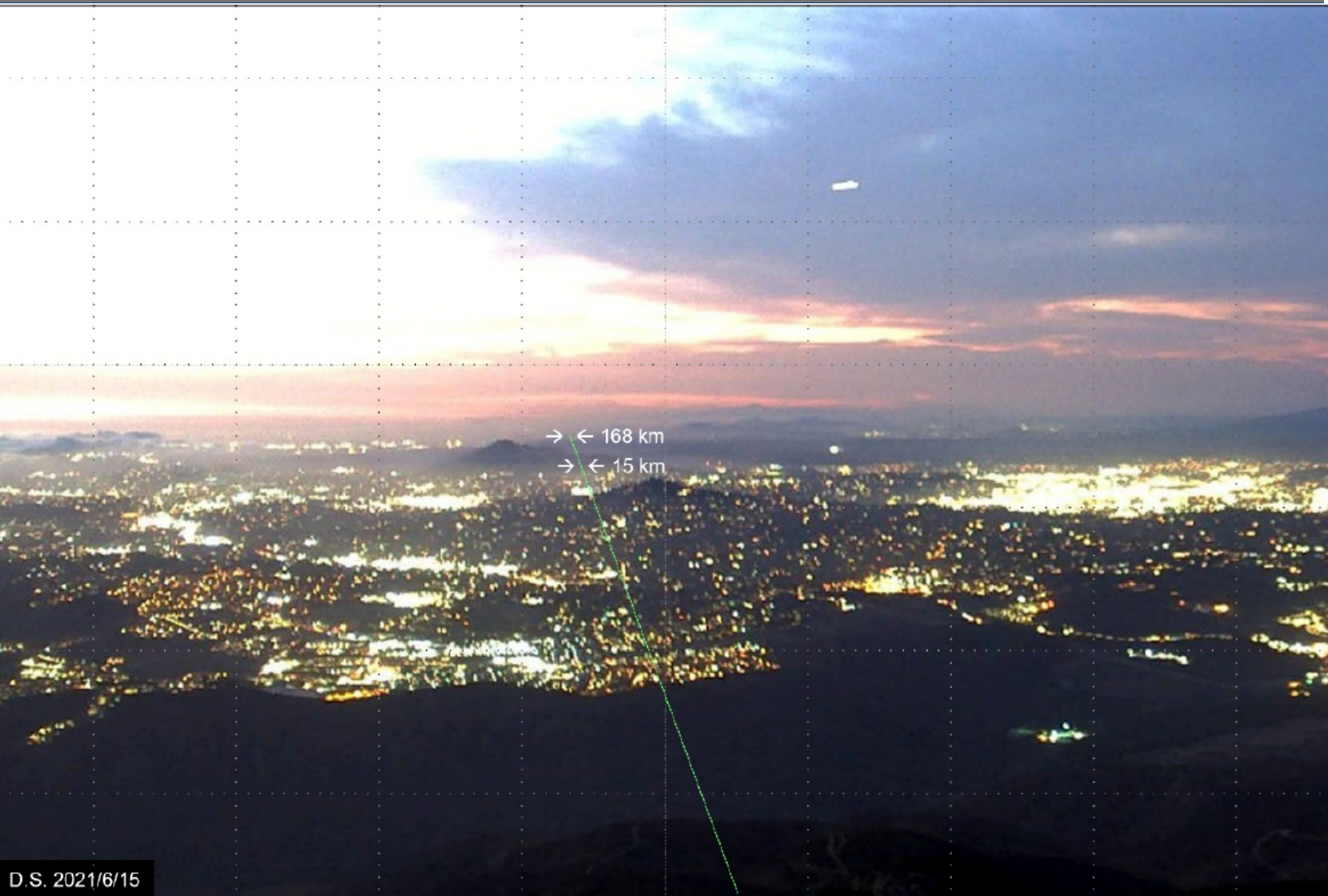


Figure 3 -- This northerly view from the Mt. San Miguel beacon site shows the propagation path geography. This view suggests a clear line of sight propagation path. We are also interested in optical communications experiments. The city lights in the image suggests potential microwave and optical interference sources if receiving at Mt. San Miguel. This image was from the real time HPWREN camera network (<http://hpwren.ucsd.edu/cameras/SM.html>)

168 KM BEACON PROPAGATION MEASUREMENTS

The long range receive site was a hill top location (DM13AW) 168 km North of the SDMG microwave beacons. Several types of beacon measurements were made using a Keysight FieldFox microwave analyzer.

- 1) The spectrum analyzer function was used for general test setup and EMI identification
- 2) Simultaneous multi frequency power measurements of up to 20 beacon and noise reference frequencies were made at 1 minute intervals over a 24 hour period.
- 3) Hour long duration IQA / SDR measurements provided a detailed look at the spectral width and identification of aircraft scatter.

Various horn and parabolic reflector receive antennas were used. The most significant measurement issue was strong out of band cellular, WiFi and other electromagnetic interference. Some limited results were obtained using a wideband horn antenna with a LNA. The best results were obtained using separate antennas, EMI rejecting beacon band pass filters and LNAs optimized for the different beacon frequencies. Good measurements were obtained at L, S and X-band. The predicted 168 km free space line of sight receive power for a 16 dBi gain receive antenna at L,S,C,X beacon frequencies is: -74, -96, -118, -123 & -106 dBm

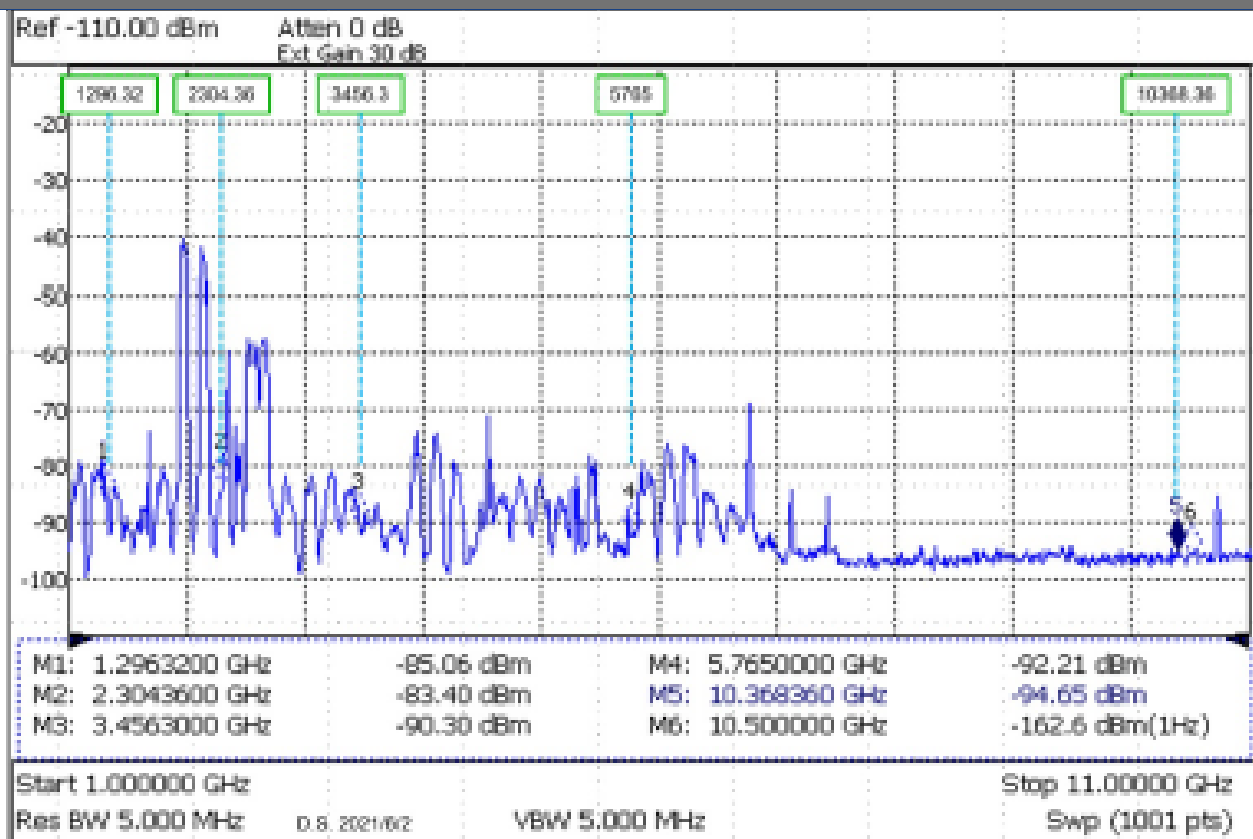


Figure 4 -- EMI environment at DM13AW - This plot shows the high levels of EMI interference at the receive site. The strongest interference is 4G AWS cellular signals just below the 2304.36 MHz beacon. Other significant interference includes SDARS, WCS-B along with 2.4 and 5.8 GHz WiFi

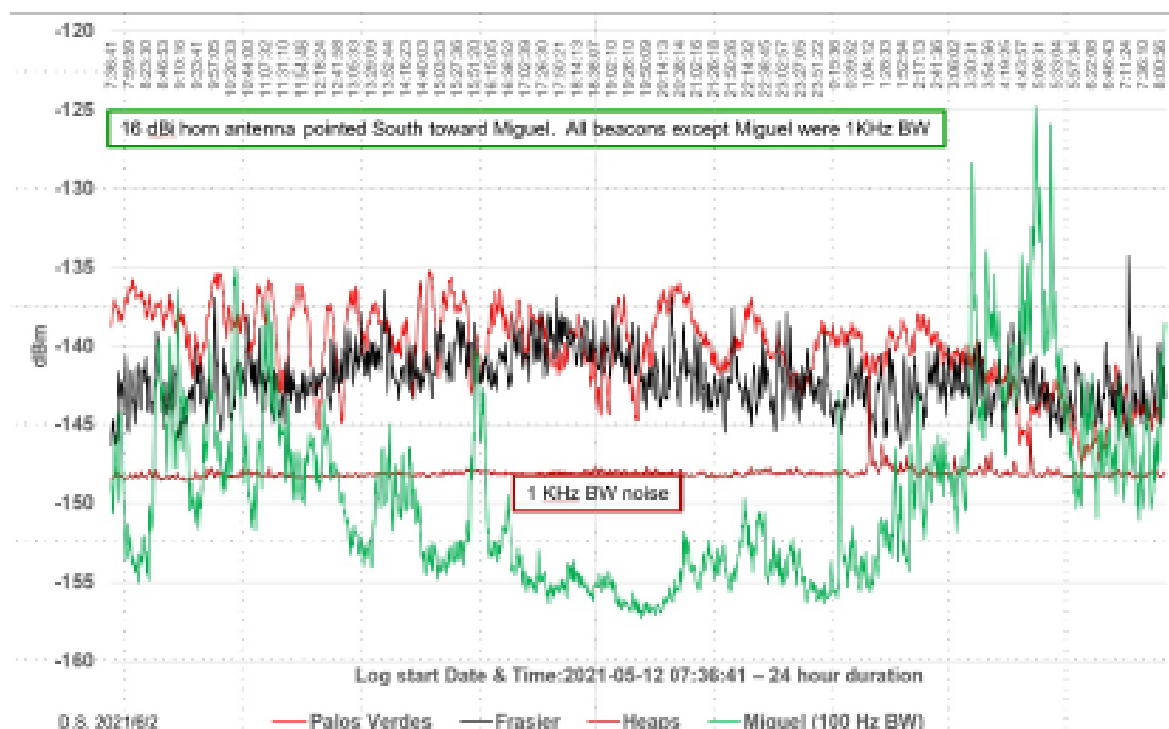


Figure 5 -- Received X-band beacon power at DM13AW - This 24 hour duration plot shows the signal strength of several SoCal beacons. The 16 dBi gain receive horn antenna was pointed South toward the SDMG beacons as that was the main measurement objective. The SDMG beacon is GPS locked so we were able to use a fairly narrow 100 Hz receive bandwidth (-158 dBm noise floor). The other beacons were measured with a larger 1000 Hz bandwidth so these measurements had a noise floor around -148 dBm. These SoCal beacon signals were likely scattered from the Santa Ana Mountain range

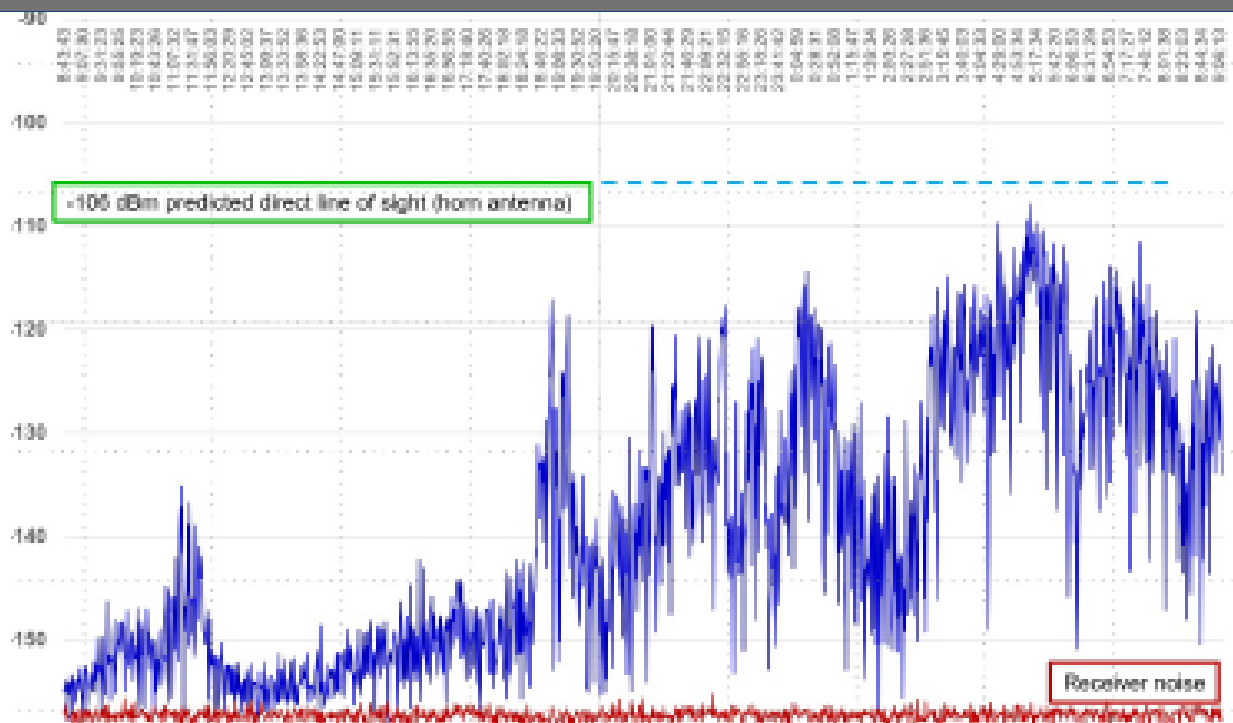


Figure 6 -- SDMGM X-band beacon power (168 km) - This plot shows the received SDMGM X-band signal strength over a 24 hour duration. The peak signal level approaches the unobstructed free space prediction for a short time. There were often multiday periods when the beacon signal is below the receiver noise floor. These signal losses were often associated with "June Gloom" weather conditions.

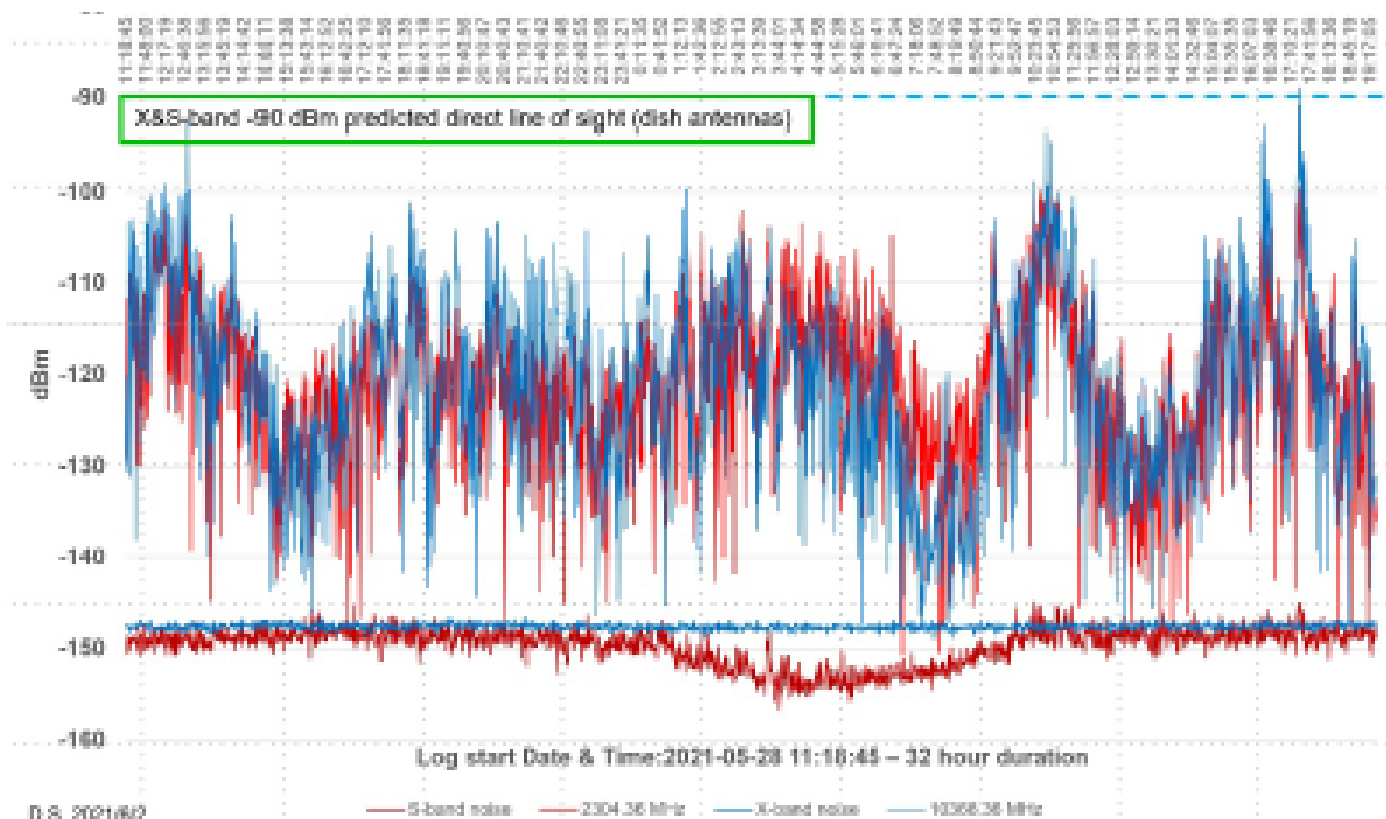


Figure 7 -- SDMGM S&X-band beacon power (168 km) - Two separate high gain parabolic reflector receive antennas operating at 2304.36 and 10368.36 MHz with separate EMI rejection filters and LNAs were combined in a diplexer. The signals vary roughly in unison but with a lot of noisy variation. The peak X-band signal reaches the -90 dBm predicted free space line of sight level. The two traces at the bottom of the plot are nearby non beacon frequencies that provide a system noise reference. The reason for the S-band midnight to 9AM noise decrease is unknown.

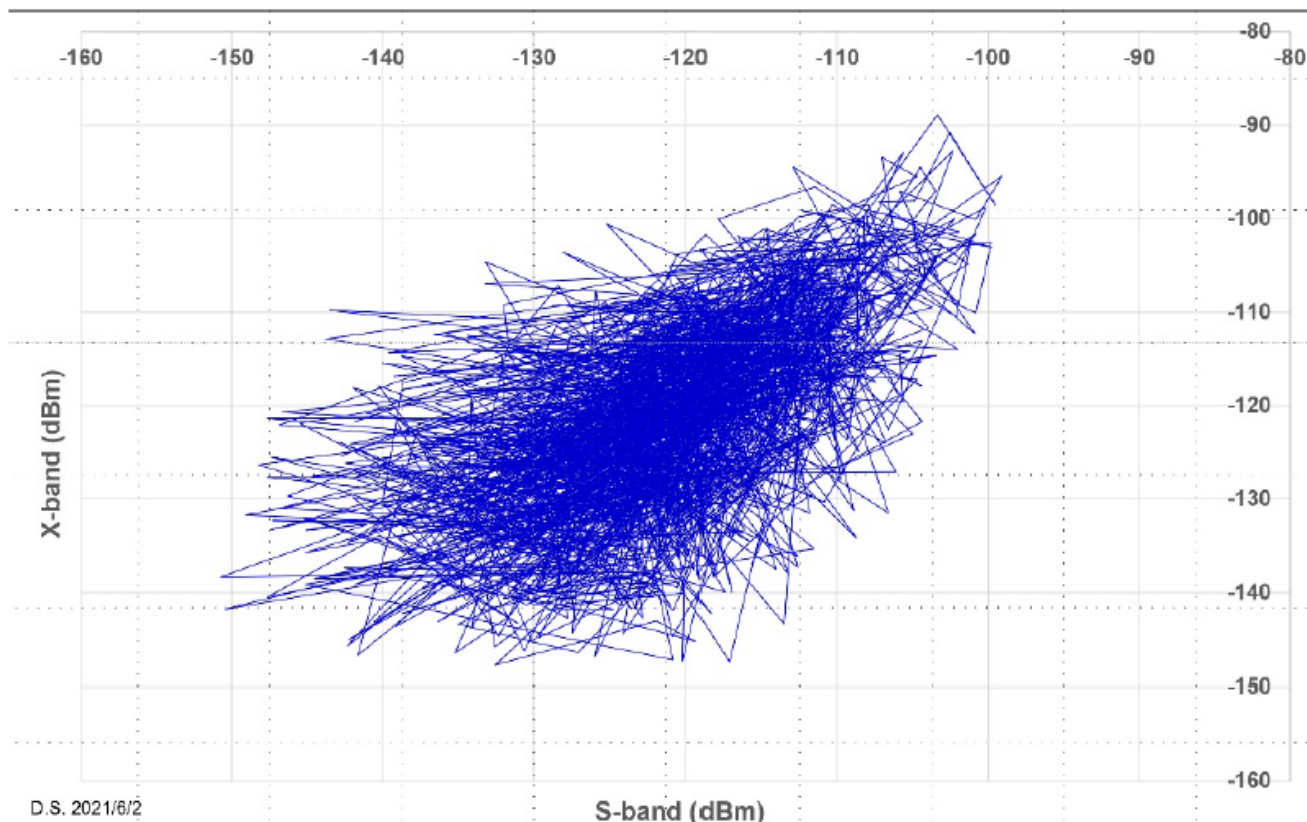


Figure 10 -- SDMG S&X band beacon correlation (168 km) - This plot shows the signal strength relationship between the S & X-band beacons. If the propagation conditions were the same for both beacons this plot would show a diagonal line. The suggestion here is that the beacons are well correlated in strong propagation conditions (plot upper right) and poorly correlated in weaker signal conditions. A lot of rapid fading was observed during the beacon measurements suggesting scintillation mechanisms. This is further backed up in the next plot.

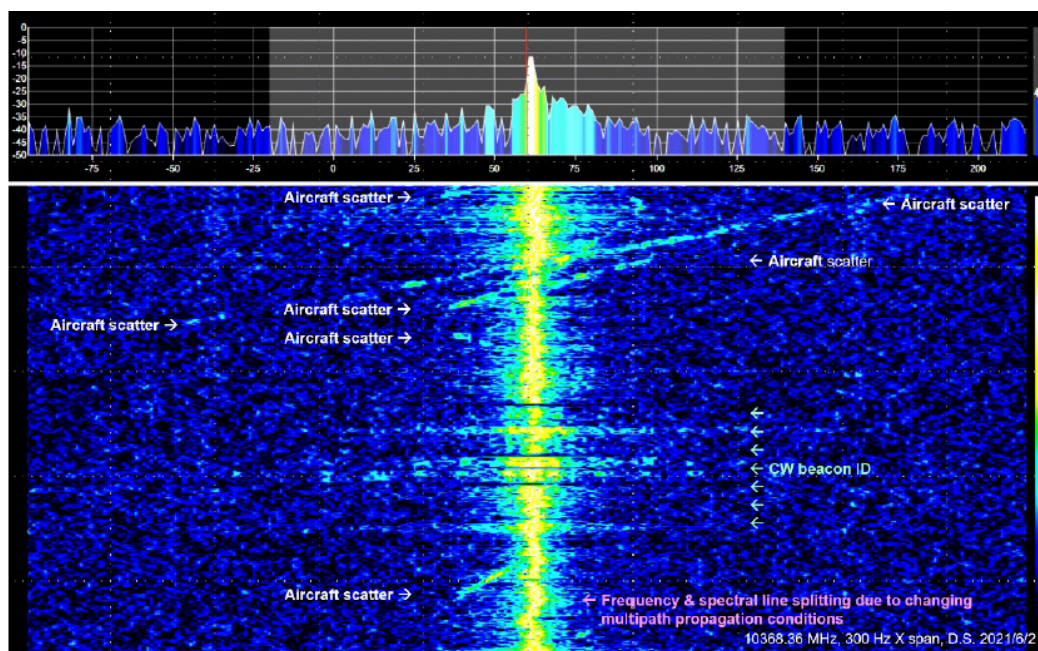


Figure 11 -- SDMG X-band beacon Doppler (168 km) - A hour long duration received signal was digitized producing an IQ baseband signal for further analysis using SDR sharp and other programs. This several minute duration plot shows 1) Beacon with frequency wander and spectral line splitting, 2) Beacon ID with the associated keyer sidebands, 3) Numerous forward scatter aircraft echoes. Sometimes these aircraft echoes are stronger than the main signal. Of most interest for future measurements is the beacon frequency wander and line splitting as this can provide further information as to the multipath mechanisms. This will require further study and improvement of both the beacon and receiver frequency stability and LO spurs, etc. See for example: <https://www.qsl.net/z1lbpu/IONO/doppler.htm>

CONCLUSIONS:

Long range propagation test results:

- 1) Do signal levels correspond to direct line of sight propagation? -- So far the answer is largely no but sometimes within a few dB.
- 2) What is the level of fading relative to free space line of sight propagation? -- Fading levels in excess of 60 dB have been observed. Sometimes continuous deep fades exist for several days.
- 3) Is multipath propagation detectable? -- Yes, spectrum line splitting, scintillation characteristics and multiple aircraft echoes have been observed.

The long range 168 km propagation path is subject to Fresnel zone losses caused by interference between the main and ground bounce path. The first Fresnel zone radius is 35 meters. Given the path elevation profile this not likely to be an issue. From our experience, temperature inversions (atmospheric thermoclines) can significantly affect microwave propagation. In the Los Angeles area, smog is typically trapped below the inversion layer, typically around 3000 ft. elevation in the Summer and lower in winter.

A thermocline is a thin but distinct thermally induced change in atmospheric refractive index that bends a microwave or optical wave up or down. If you try to go through it at some angles the signal essentially bounces off. This can be good or bad depending on which side of the thermocline both stations are located.

Greg & Kerry were doing an IR laser experiment from Miguel to Palomar some 60 miles distant. We setup on Miguel late afternoon and through the rifle scope could see the peak where the other station was located on Palomar. We could see a definite smog layer (thermocline) slightly above us on Miguel and it was below Palomar. We could not establish contact using the 1 W beam expanded 940 nm Laser. As evening came, we could see the thermocline moving down in altitude and as it dropped below us the signal became very strong as expected. While we were unable to communicate, Kerry found that moving receiver pointing rapidly would find a short snip of signal. The direction it came from would change rapidly.

Current thermocline activity can be identified using Skew-T Log-P plots

<https://scottcrosby.info/weather/skew-t.html#NKX>

https://meteocentre.com/radiosonde/get_sounding.php?stn=72293&type=rs&yyyy=2021&mm=06&dd=15&run=00&hist=1&show=1&lang=en&area=us

This was our first attempt to look at the excess frequency dependent path losses over free space conditions using the multi frequency SDMG beacon system. With improved EMI rejection filtering we should be able to monitor all SDMG beacons simultaneously. We are interested in attempting optical com over this same path. Current in work improvements include: Better beacon frequency stability (K6QPV), development of EMI filters & optical transmitter (N6LZW) and an improved portable multiband receive system & optical receiver (AG6HF). Also needed are weather recordings over the propagation path for correlation with the observed propagation conditions.

2021/6/20

SAN BERNARDINO MICROWAVE SOCIETY

HOME TO HOME ~ ERRATA

Home to Home - Wednesday Evening (Before the Monthly Meeting)

- 10,368.100 MHz - Calling Frequency {Please refer to Odds & Ends for more information}

Notes from previous HOME-TO-HOME events:

Editors Note: If your on the H2H (Home 2 Home) please take a moment and drop me a note on your efforts. Does not have to be detailed, but your location you are operating from, the elevation, and the mode... i.e. SSB, FM, Digital.

Thank You! ~Steve WA6OXN@gmail.com

I am trying something new for the H2H. There is a huge amount information that is discussed between the H2H operators, especially with WSJT configurations and settings. So I am recording off-the-air with a VOX type recorder (so you don't have to listen to all the dead air time) and I will link the recording so you can either copy and paste the link, or click on it and listen from within this newsletter. The recordings are then uploaded to YouTube.com for playback at your convenience.

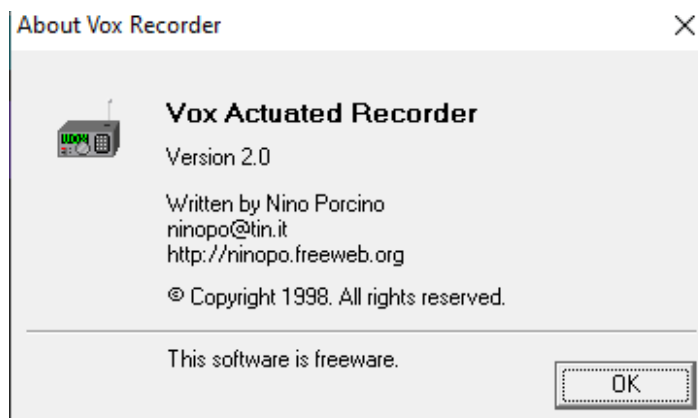
Previous Home-2-Home Recordings:

Preliminary Recorder Test on June 03, 2021.

<https://youtu.be/64Si5ZaFYnk>

<https://youtu.be/KmG4FlcRNrw>

Note: Conducted some other off-the air tests with different types of software. This was the software that worked best for me.



March 2, 2022 Home-2-Home Recording:

H2H activity began at approximately 1845 Hrs. I heard the following operators Wednesday evening on the Cactus liaison channel.

W6DL Dave Laag Temecula, CA [Remote - Hilltop]

N6CA Chip Angle Lomita, CA [Home]

N6RMJ Pat Coker Bullhead, AZ [Remote - Close to Home]

WA6CGR Dave Glawson Wilmington, CA [Home]

AF6NA Brian Thorson Eastvale, CA [Home]

Mel WA6JBD and Robert KM6RXN dropped in to say hello to everyone.

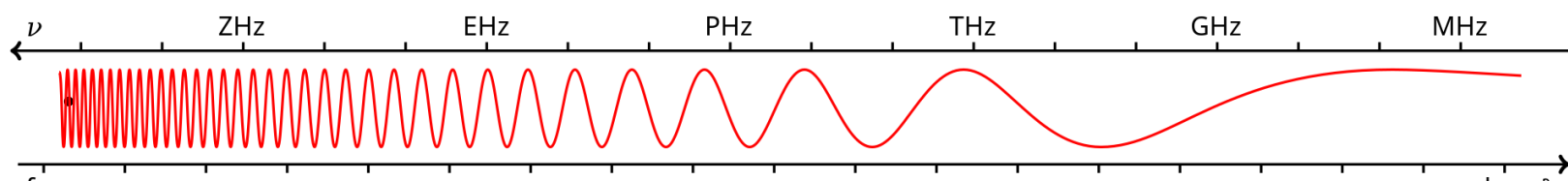
>Darn it... *Lost the first 30 minutes or so of recording:* (

Wednesday March 2, 2022 - SBMS H2H Home-2-Home

H2H Recording No.1: <https://youtu.be/XbkafaWAmAU>

2022 EVENT SCHEDULE

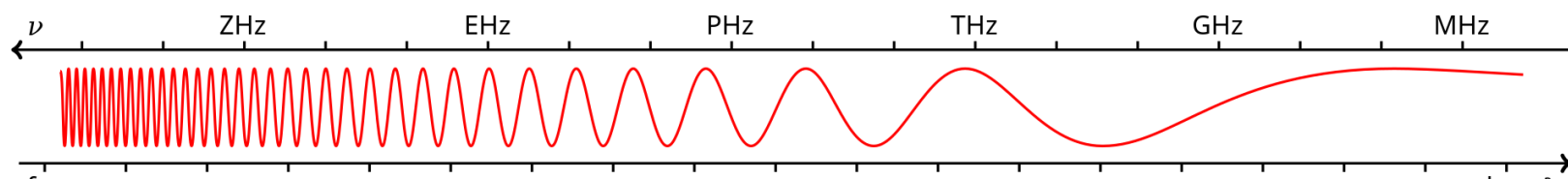
- Jan 6 SBMS Meeting In-Person + ZOOM Video Conferencing
- Feb 3 SBMS Meeting In-Person + ZOOM Video Conferencing
- Mar 3 SBMS Meeting In-Person + ZOOM Video Conferencing
- Apr 7 SBMS Meeting In-Person + ZOOM Video Conferencing
- May 1 - 2 SBMS 2 GHz & Up Contest
- May 5 SBMS Meeting In-Person + ZOOM Video Conferencing
- May 17 - 19 Maker Faire, San Mateo, CA (EVENT CANCELLED)
- June 2 SBMS Meeting In-Person + ZOOM Video Conferencing
- June 11 - 13 ARRL June VHF Contest
- June 26 - 27 Field Day
- July 7 SBMS Meeting In-Person + ZOOM Video Conferencing
- July 30 SBMS Microwave Tune-up (Last Saturday of the month)
- Aug 4 SBMS Meeting In-Person + ZOOM Video Conferencing
- Aug 6 - 7 ARRL 222 MHz & Up Distance Contest
- Aug 20 - 21 ARRL 10 GHz & Up Contest - Part 1
- Sep 1 SBMS Meeting In-Person + ZOOM Video Conferencing
- September 17 - 18 ARRL 10 GHz & Up Contest - Part 2
- September 17 - 18 ARRL EME Contest, 2.3 GHz & Up



2021 EVENT SCHEDULE

- Oct 6 SBMS Meeting In-Person + ZOOM Video Conferencing
- Oct (date TBD) Microwave Update, Dulles Airport, VA
- Oct 15 - 16 ARRL EME Contest, 50 to 1296 MHz. Part 1
- Nov 3 SBMS Meeting In-Person + ZOOM Video Conferencing
- Nov 12 - 13 ARRL EME Contest, 50 to 1296 MHz. Part 2
- Dec 1 SBMS XMAS Meeting In-Person + ZOOM Video Conferencing

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MICROWAVE BEACONS CALIFORNIA - ARIZONA - NEVADA

Southern California

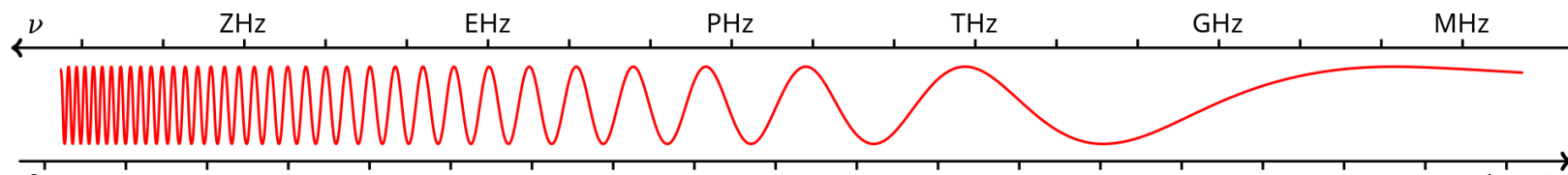
Heaps Peak	2304.320 MHz	W6IFE/B	.5W (+27dBm)	
	Grid: DM14kf	Lat/Long: 34°14' 5", -117°8' 26"	Altitude: 6435'	
Heaps Peak	10368.330 MHz	AF6HP	2W	
	Grid: DM14kf	Lat/Long: 34°14' 5", -117°8' 26"	Altitude: 6435'	
Frazier Mtn.	10368.310050 MHz	N6CA/B	1.1W 15dbi Horizontal Polarization WG Omni	
	Grid: DM04ms	Lat/Long: 34.7751, -118.96948	Altitude: 8027'	
Santiago Peak	Beacon Relocated to Heaps Peak			
	Grid: DM13fr	Lat/Long: 33.7109, -117.53401	Altitude: 5681'	
Palos Verdes	10368.300 MHz	N6CA/B	1.6W (Out of Service)	
	Grid: DM03ts	Lat/Long: 33.7676, -118.37642	Altitude: 1200'	
Mt. San Miguel	Grid: DM12mq	Lat/Long: 32.6979, -116.93516	Altitude: 2500'	
	10368.360 MHz	K6QPV/B	1W	
	5760.300 MHz	K6QPV/B	2W	
	3456.300 MHz	K6QPV/B	10W	
	1296.300 MHz	K6QPV/B	12W	

Arizona

White Tanks	10368.375MHz	W7ATN/B	2W	
Bullhead City	All 10ghz Freqs! N6RMJ Pat Coker (Unofficial Arizona Beacon)			
	Grid: DM25RE	Lat/Long: 35.1847, -114.53298	Altitude: 541'	

Nevada

- The newsletter editor is looking for information on working Nevada beacons. Thanks!



MICROWAVE BEACONS CALIFORNIA - ARIZONA - NEVADA

Northern California

For more information regarding the Northern California Microwave Beacons refer to this website:

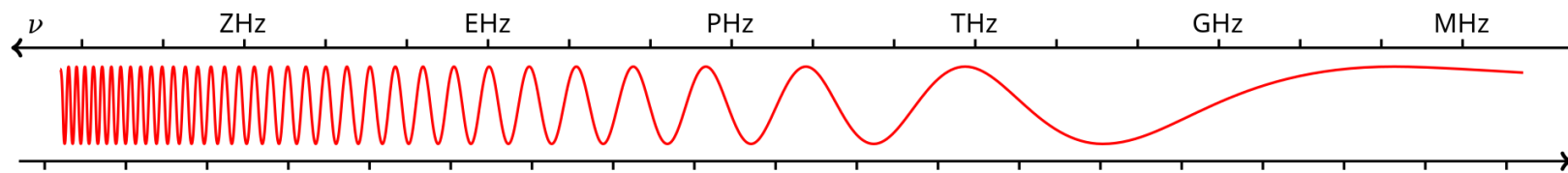
<http://50mhzandup.org/>

Here is our document about the upgrade and operation of the Mt Allison Beacon

[Please click here to view or download](#)

Microwave Beacons in operation The following beacons are known to be operating as of 01-29-2021:

Name	Grid	Coords	Freq	Call	Power	Ant	Comments
Stanford University	CM87WJ	37.403, -122.165	122400.000	K6ML	+2 dBM ERP	70 degree horn aimed E	CW ID, locked
Mt Vaca	CM88wj	38.415, -122.116	10368.325	W6ASL	+30dBm	10dBi omni	CW ID
Mt Allison	CM97bl	37.500, -121.872	working 10369.001 24192.010 47088.000	K6MG N6NU/B KF6KVG	not measured +13dBm +7dBm	10dBi omni " 12dBi omni +20 dBi horn 27 deg beamwidth, aimed SW	CW ID, locked, S-meter output Linear translator: Output is 1KHz-40kHz above beacon Input 600 kHz below desired output CW ID locked CW ID locked
Mt Leeson	CM97ae	37.167, -121.924	10367.990 24191.975 47087.99 79919.92	KF6KVG	+20dBm +20dBm +5dBm -5dBm	2.5" horn 1.5" horn 1.25" horn 0.6" horn	FM ID, locked, aimed NW FM ID, locked, aimed NW FM ID, unlocked, aimed NW no ID, locked, aimed NW
Bear Mtn being rebuilt	DM06ir	37.747, -119.281	24191.990	W6BY/B	+27dBm	20 slot omni	locked, IDs as DM07IC, will fix
Mt Frazier	DM04ms	34.775, -118.969	10368.310	N6CA/B	+31dBm	14dBi omni	CW ID, locked



SAN BERNARDINO MICROWAVE SOCIETY ODDS & ENDS

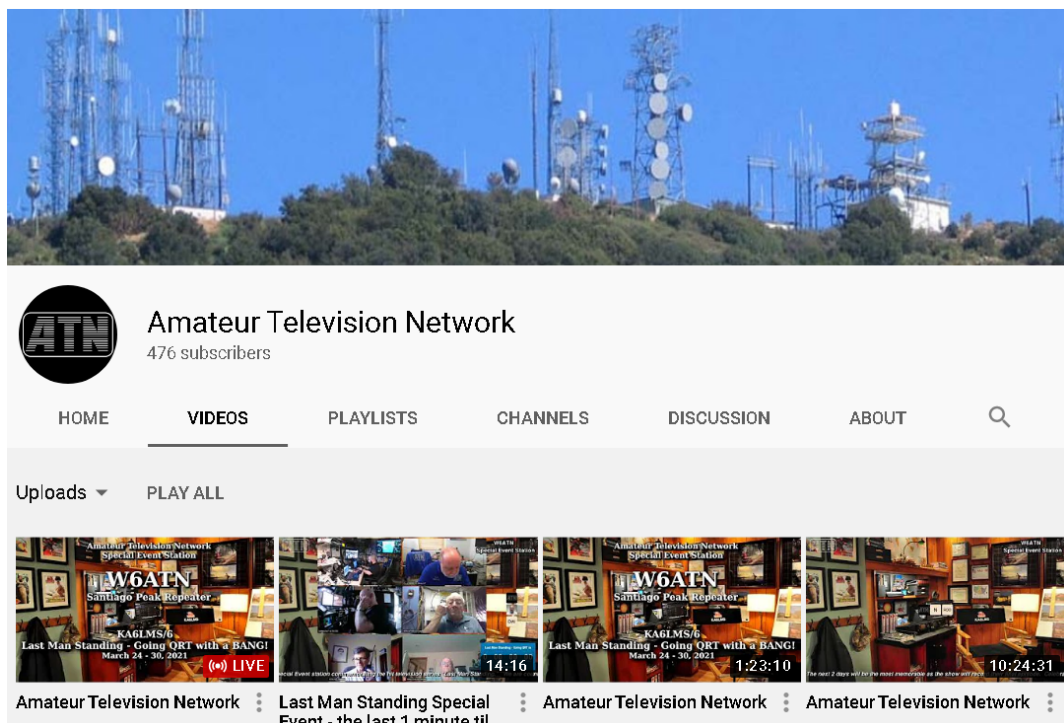
SBMS Zoom & Future Live Meeting Streamed Live on YouTube !!

SBMS members and HAMS throughout the world should be very glad the Amateur Television Network has made it's content available LIVE via the YouTube streaming service.

To access our Amateur Television Network's live stream, go to YouTube (<https://www.youtube.com>), and search for "Amateur Television Network". When it is the evening of the meeting and Roland has made the connection over the internet, you will see the familiar ATN logo and the words "LIVE NOW" box appearing in the description.

Just click the screen and you will be watching our live feed. When you get there to watch or even if you go there now, click on "Subscribe".

Subscribing is necessary to use the youTube comment section as a kind of chat system where you can interact, be a part of the rollcall, and "attend" the SBMS meeting.

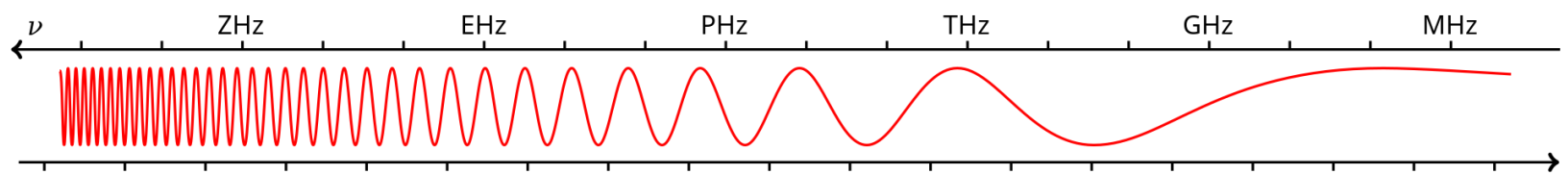


SBMS "Dinner-Before"



"Dinner-Before" is like a people capacitor in that it is a gathering place for those who are trying to head to the monthly society meeting and beat that SoCal traffic. Some arrive as early as 4:00pm. Drop an email note to the reflector for more info or to announce your coming in early, or use the Cactus Intertie System and give a shout out when you are heading in...

- Sizzler Restaurant located at 1461 Rimpau Ave. Corona, CA 92879



SAN BERNARDINO MICROWAVE SOCIETY ODDS & ENDS

Home to Home - Wednesday Evening Before the Monthly Meeting

Rein Smit, W6SZ (based in Alta Loma), Past President of SBMS is encouraging all Southern California microwave hams to try contacting each other from their QTH the night before the SBMS meeting. The intent is to learn home to home capabilities and to discover tricks to use them.

- 10,368.100 MHz - Calling Frequency SSB, CW, FM, and Digital (basically any mode) will work.
- Please make sure to send a follow up report (successful or not) to V.P. Robert Carter KM6RXN,
- email: laserdog3@juno.com. Please include your callsign, name, date, time, and general location.

WA6JDB, N6RMJ and W6SZ will be looking & listening for your signals along with other society members. For coordination and liaison, we will use the LARA/Cactus repeater located on Heaps Peak, so our desert participants can check in also. Newcomers are welcome ! Receive only setups are welcome !!

We'll be listening to Cactus/Heaps starting at around 20:00 PDT and going until the last person gives up.

- Repeater frequency is 448.860 out / 443.860 input / PL 100.0
- It will be configured in a standalone mode so it does not bother the rest of the Cactus Intertie System.

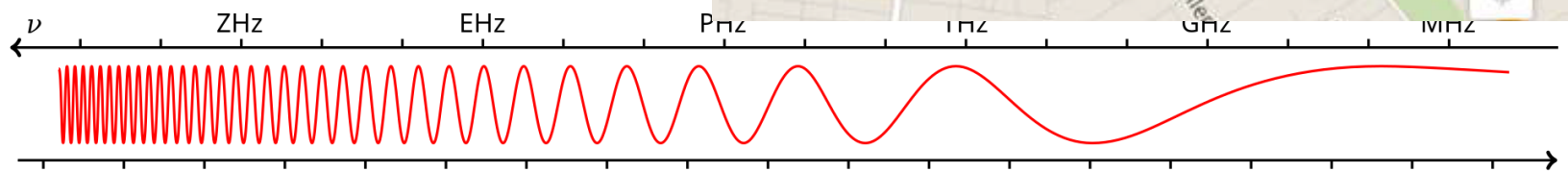
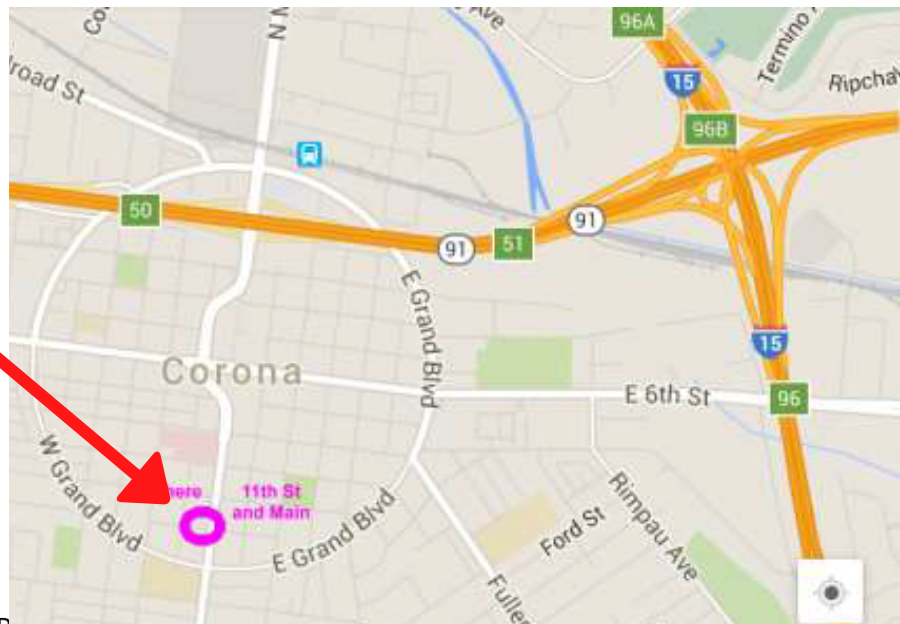
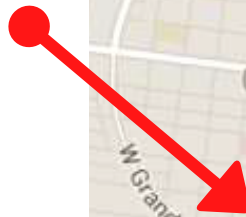
SAN BERNARDINO MICROWAVE SOCIETY - MEETING LOCATION

The Society meets on the first Thursday of the month, officially starting at 7:00 PM. All are welcome to come early to assist with meeting setup, fellowship, technical assistance, or the bringing of surplus items to give-a-way, trade or sell !

Bring your latest project with you, a cool piece of microwave gear, or test equipment to share !

American Legion Post 216
1024 S Main St, Corona, CA 92882

For more information, or to Carpool from
North Orange County, please contact:
Dick Bremer WB6DNX - 714-529-2800
rabremer@sbcglobal.net





SAN BERNARDINO MICROWAVE SOCIETY, Incorporated

FOUNDED IN 1969

A NON-PROFIT AMATEUR TECHNICAL ORGANIZATION DEDICATED
TO THE ADVANCEMENT OF COMMUNICATIONS ABOVE THE REST